GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

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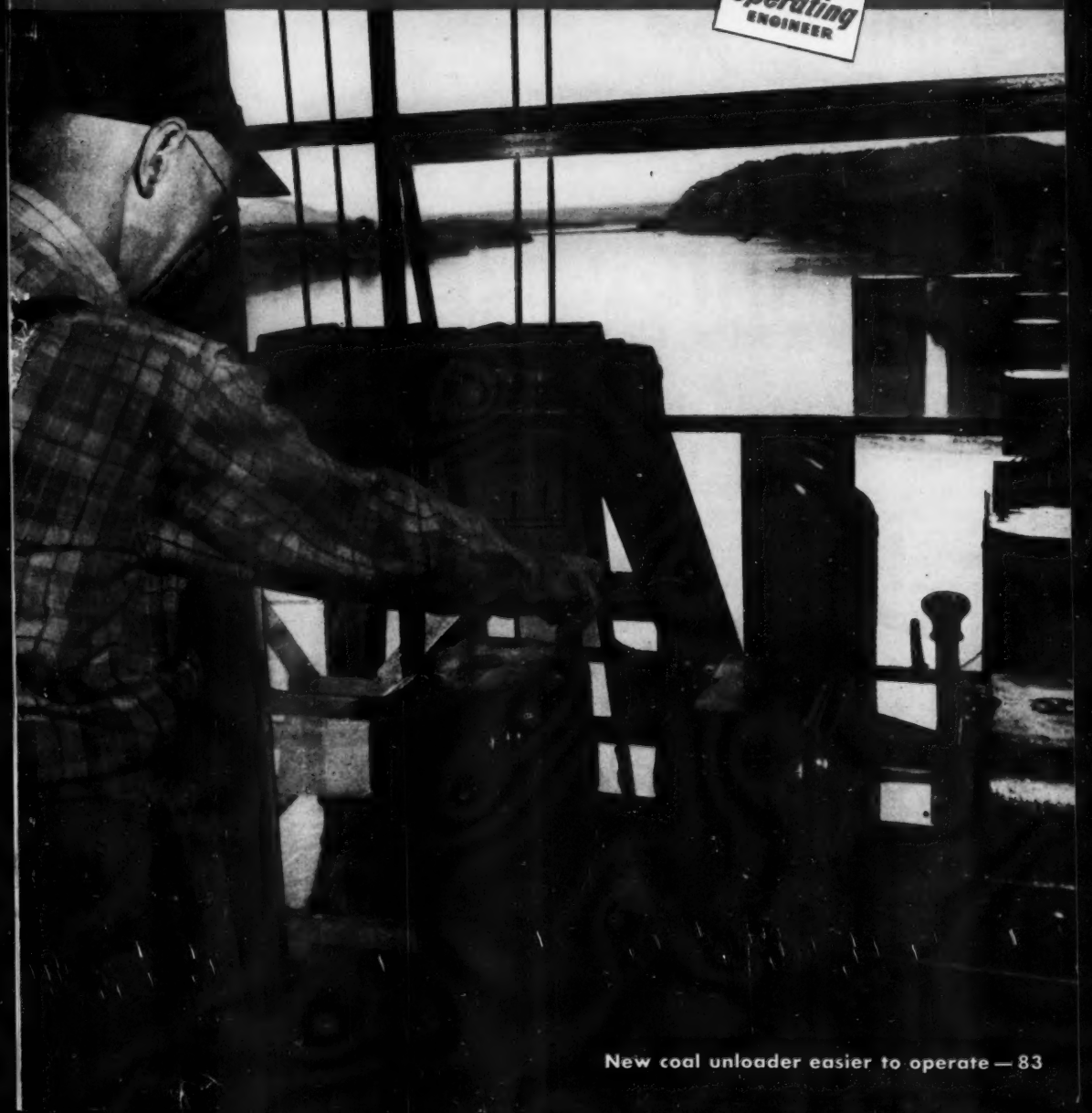
Power

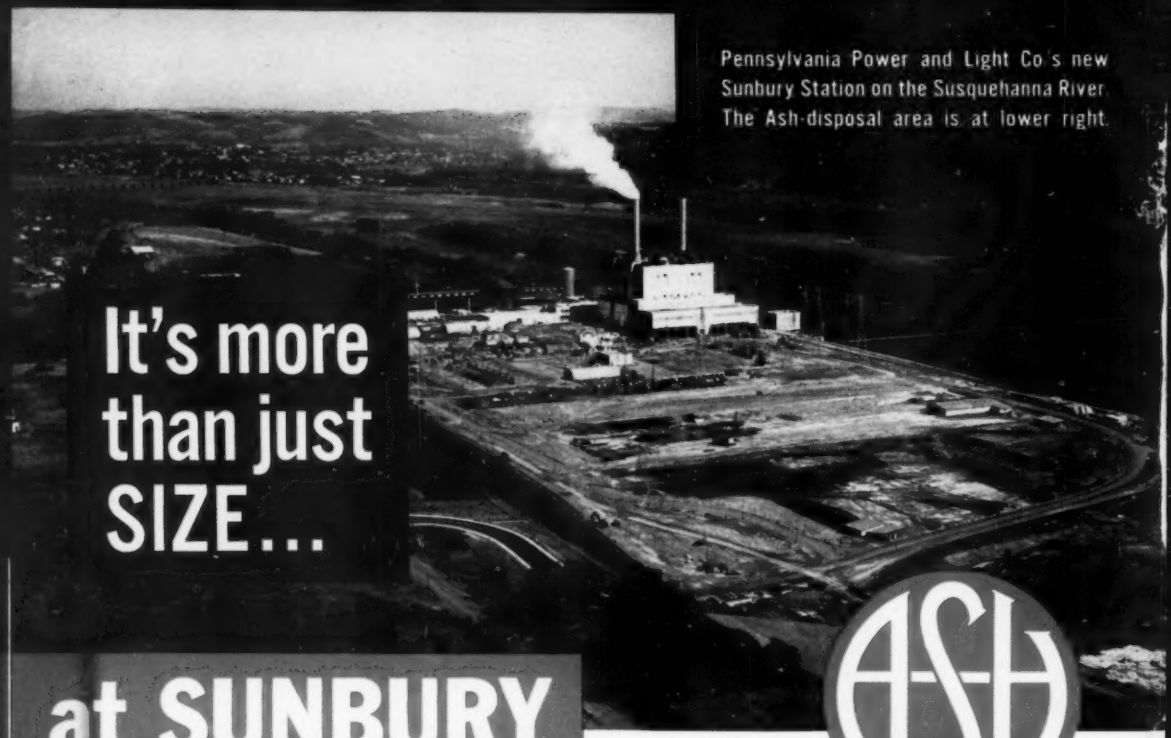
June
1951

A McGRAW-HILL PUBLICATION

combined with Operating ENGINEER



New coal unloader easier to operate — 83



Pennsylvania Power and Light Co.'s new Sunbury Station on the Susquehanna River. The Ash-disposal area is at lower right.

It's more than just SIZE...

at SUNBURY

ASH

Over 2,000 tons of coal are needed every day to feed the furnaces of the first two units at the new Sunbury Steam-Electric Station of Pennsylvania Power and Light Company, the world's largest power plant burning pulverized anthracite. Sunbury's steam generators can produce 1,600,000 lb-per-hr, and additional generators, now under construction or in the engineering stage, will add another 1,800,000 lb-per-hr. The 259-acre Sunbury plant site is adequate for development of ultimate capacity somewhat in excess of 700,000 kw.

Besides being a giant among power plants, Sunbury is notable for its high efficiency. For example, heat release at maximum continuous rating is only 8520 Btu-per-hr-per-cu-ft. Also, in spite of its size, it can be operated by a comparatively small station crew. One of the reasons for this is the use of Hydrojet and Hydrovac for ash and dust handling. With a minimum of time and attention, these systems discharge approximately fifty tons of ash and twenty tons of dust from the plant per operating hour.

Ash-laden water entering grid-protected pump pit.

Large or small, your power plant will operate more efficiently with these modern systems. Tell us your problems and, without obligation, we'll gladly recommend the most satisfactory solution for you.

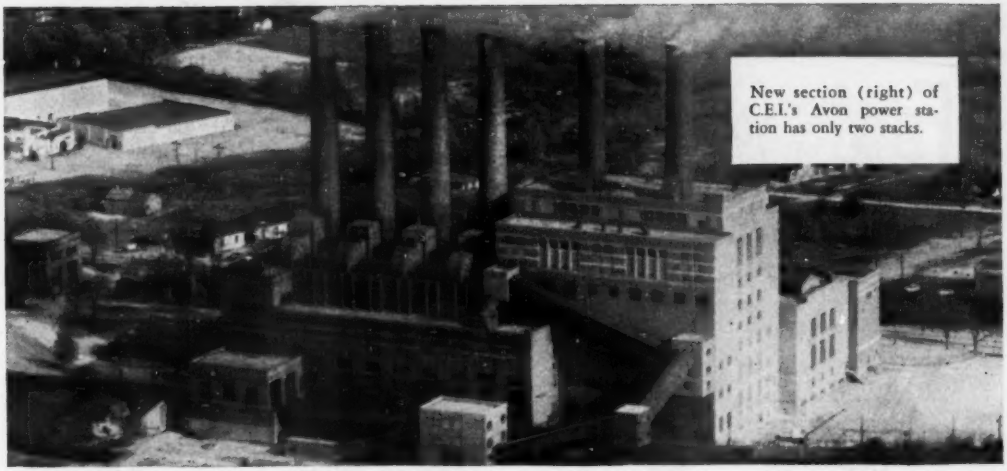
THE ALLEN-SHERMAN-HOFF CO.

227 South 15th Street, Philadelphia 2, Pa.

Offices and Representatives in Principal Cities

HYDROJET (hydraulic) HYDROVAC (pneumatic)

materials handling systems

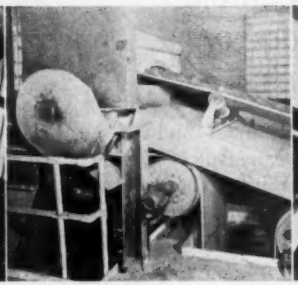


New section (right) of C.E.I.'s Avon power station has only two stacks.

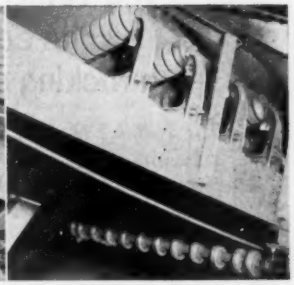
25 years ago... and again today...

Cleveland utility relies on LINK-BELT

On its way to crushers from railroad car dumper hopper, coal moves on a 48 in. wide, 218 ft. long Link-Belt belt conveyor equipped with Series 100 idlers.



Differential back-stop and gravity take-up at head end of this belt conveyor assure trouble-free operation.



Rubber treads save belt at foot end—upper idlers absorb shock of falling coal, lower one cleans its surface.

LINK-BELT integrates coal handling system for old and new sections of Avon generating plant

WHEN the Cleveland Electric Illuminating Co. nearly doubled the capacity of its Avon station, Link-Belt was the logical source for coal handling equipment. For, when the original plant was built in 1926, it was Link-Belt equipped.

Part of the original conveying system—still going strong—is retained in the new set-up which can deliver 1000 tph to the new section's bunkers, split the 1000 tph between old and new sections, or merely carry 500 tph to the old section. Included in the system are automatic methods for maintaining belt tension and alignment, for sampling, for arresting backward travel in the event of power interruption, and for stopping conveyors in proper sequence should trouble occur.

True 25 years ago . . . true today. Link-Belt is your best bet for coal handling. Nowhere else can you tap such resources of experience, engineering, quality equipment and completeness of line. Whatever the size or type of your plant, Link-Belt engineers can help you come up with the right answer for more efficient coal handling.

12.347

LINK-BELT

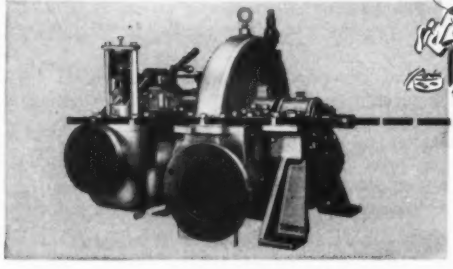
COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in Principal Cities.

Facts you should know about De Laval turbines!

Which would you rather sit on, a knife edge or a rocking chair?

The rocking chair, of course! And it's the same with the "rocking chair" type of governor pivots in De Laval turbines. The governor weights are pivoted on frictionless rolling surfaces. There are no heavily loaded knife edges subject to concentrated wear. This means smooth, positive action. Keeps your maintenance costs down, too.



Putting support where it counts most!

Thermal expansion can't throw a De Laval turbine out of line with the driven machine because the body is supported at the *exact centerline* to allow for radial expansion. The front end is mounted on a flexible channel to allow for axial expansion. Thus, both radial and axial expansion can take place under extreme temperatures without disturbing the shaft centerline.

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

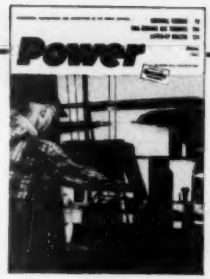
50th DE LAVAL Anniversary

T-35

Power

JUNE 1951 VOLUME 95 NO. 6

combined with Operating ENGINEER



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(Member ABC and ABP)

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own index annually, copies of which are available on request to the editorial offices.

COAL UNLOADING from river barges usually calls for quite a bit of manual skill. We can still remember watching the operator in our old plant working controls with both hands and feet in a fascinating pattern. A topnotch operator, gifted with hair-trigger coordination, could make that 5-ton bucket really do tricks.

Now the engineers are doing the tricks, and life for the operator promises to be a lot easier. In the new Dravo-designed coal tower at Philips Station, pictured on our cover, only two hand controls do the job. That's only one of many ingenious features of this ac-powered unloader—read about them in the story beginning on p 83.

Next month...

■ Long awaited Part II of the POWER Handbook comes along in July. Packed into its 32 pages is practical dope on: feedwater treatment, fuels, combustion, boilers, turbines, gas and diesel engines, fans, compressors, refrigeration, heating, air conditioning, heat transfer, electrical machinery, lubrication, heat insulation.

Part I made such a hit with readers all over the world that we're really sweating it out to make Part II as big a success.

■ Keep an eye out for another Shep Powell article on chemical feeders and the second of Don Swift's "shorts" on trouble-shooting headaches.

■ Ever taken off a lot of handhole plates and then cussed when you ran into trouble getting them back tight? You'll find the pointers you need for a smooth-running and successful job in the next Operators' Notebook.

...and future months

With the drought season coming up, water-supply problems again promise to move into the limelight. You'll want to watch for John Murphy's big piece on wells—types, pumping setups, operation and maintenance steps to keep them flowing full at all times.

OUT GO RUST, SLUDGE AND FOAM

When TEXACO REGAL OILS (R&O) go *IN*

To assure the full-time, full-power turbine performance that present-day production schedules demand, lubricate with *Texaco Regal Oils (R&O)*. For years before the development of rust- and oxidation-inhibiting additives, *Texaco Regal Oils* were world-famous turbine oils. Now, *with* these effective additives *plus* special foam-resistant properties, *Texaco Regal Oils (R&O)* assure better-than-ever performance.

With *Texaco Regal Oils (R&O)* in your turbines, rust, sludge and foam don't have a chance. Bearings get full protection, and governor action is sensitive and alert. *Texaco Regal Oils (R&O)* give you an extra-long oil service life . . . need less attention. Result—a greater margin of safety and lower maintenance costs.

Texaco Regal Oils (R&O) are approved by leading turbine builders and are available in every needed viscosity.

A Texaco Lubrication Engineer will gladly help you to greater efficiency and economy throughout your plant. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.

Power

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...with 'more' Power readers...

This month we're taking our "letters" column, and an extra page besides, to give you a sample of what readers think of POWER *combined with OE — what we like to call the "more"* POWER. *Here goes:*

"MASTER STROKE" . . .

Feeling like a father to *OE*, having contributed articles since its inception, I might have thought I had lost a dear one when the merger was announced. But, looking through the April issue, you have pulled a master stroke in combining the two.

It must have caused confusion to many as to which to read. I subscribed to both, feeling that I received plenty from each.

I really use these magazines. I keep several years' issues always at hand and I cut out articles I may need before discarding older issues. . . a great part of my knowledge and training I owe to the pages of POWER.

Bronx, N. Y. GEORGE GRIFFEL

(It's a two-way street, Mr. Griffel. Editors get a lot from readers.—Ed.)

"TWICE AS GOOD NOW" . . .

Nothing much could be done to improve such an excellent magazine as

Turn page for more reader comment

...lines and bylines

MAINTENANCE RECORDS are the essence of Frank Hinchcliffe's prescription for economical, reliable operation. At Lachine plant of Northern Electric, Ltd (p 86) his card file tells him the life history of each item of equipment, its dimensions, its performance, and what it costs to keep in service. Tabs on cards show at a glance when a machine is due for inspection or overhaul, and when the job is done.

Frank A Hinchcliffe

Frank built up his operating philosophy during 25 years in the power-plant game—both in England, where he was born, and in Canada, to which he came in 1921. Before taking his present position he served as powerhouse superintendent at Dominion Engineering Works, Ltd, and at Canadian Arsenal, Ltd.

Past-president of Montreal branch of the Institute of Power Engineers, and active in Boy Scout work, Frank finds time for amateur photography (including plant pictures) and woodworking.

FUELS RESEARCH has had Elmer Kaiser's unswerving loyalty since he graduated from Wisconsin in 1934 with a BS and MS in mechanical engineering. The next year he slipped right into their coal laboratory as graduate assistant.

Elmer R Kaiser

With Battelle Memorial Institute until 1944, Elmer researched pretty near everything in the fuels line, from small household stokers to large underfeeds at Manhattan's Hell Gate Station. Then after a spell of raising funds for the coal industry's program, he joined Bituminous Coal Research as assistant director of research, the post he now holds.

Kaiser's non-fuel interests center around color photography and traveling. He's going to give both a workout this summer on a six-week European trip. He says he wrote the paper on which our article is based (p 92) to clear up his own thinking and help chart new research on reducing dust from spreader-fired boilers.

BATTEN THE HATCHES! Lash down the cargo! Man the bilge pumps! Here's that ace marine and stationary engineer, Marmaduke Surfaceblow, making a bow to POWER readers who've seen some of his wild yarns and, quite naturally, wonder where he comes in.

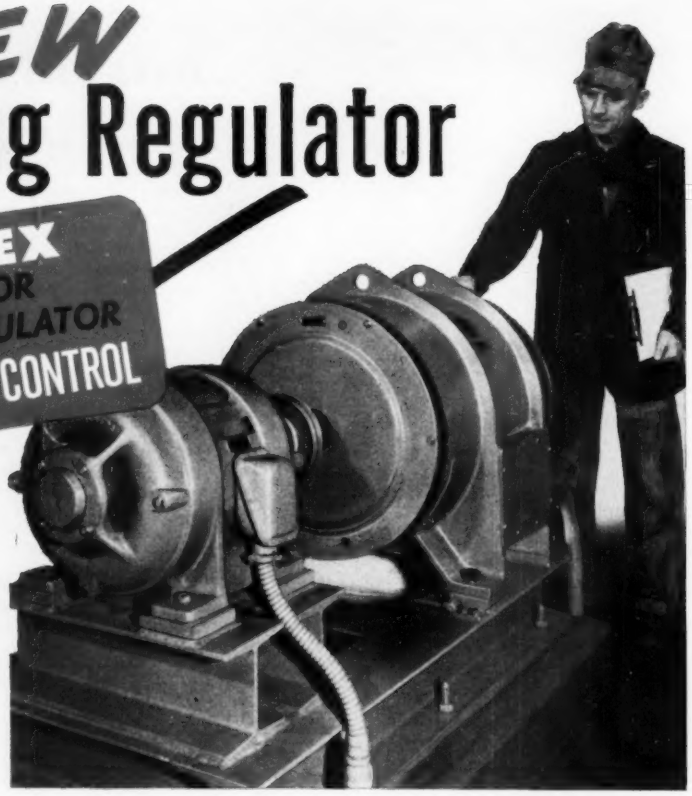
Marmaduke Surfaceblow

Well, Marmy is a cantankerous old windbag. Ever since the day four years ago when he turned the wrong corner looking for Bedlam's Bent Propeller Bar and landed in Phil Swain's office, he's been *OE's* editor extraordinary — and we do mean "extraordinary."

If he's been to a tenth of the places and done a twentieth of the things he sounds off about, he must be older than Methuselah. Don't ask us why he lubricates with Sandpaper Gin. And we don't know why his fan mail grows with each story—but that's the way it is. You can take this character or leave him alone. After all, it's a free country—no one can make you read the yarn on p 150.

NEW Rotating Regulator

REGULEX
GENERATOR
VOLTAGE REGULATOR
POWER PLANT CONTROL



1 Minimizes the effect of disturbances caused by sudden load changes and fault conditions.

2 Controls generator excitation so as to increase safe operating limits.

3 Provides proper division of reactive current between synchronous machines operating in parallel when a cross current compensator is applied.

4 Provides accurate, sensitive voltage control.

5 Functions without hunting.

6 Provides high rate of excitation voltage response to restore voltage to normal as quickly as possible after a disturbance.

7 Provides alternate manual control of excitation without disturbance of the existing excitation.

WHEN SELECTING generator voltage regulators for your power plant, consider these seven big advantages of new *Regulex* control. Remember that *Regulex* control gives you pin-point accuracy while improving service continuity by reducing outages for maintenance. You can use *Regulex* generator voltage regulators on alternators, synchronous condensers and dc generators. Call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin for further information. A-3298

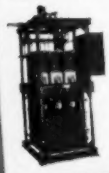
Regulex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Order Telegraph Systems

The Allis-Chalmers Order Telegraph System is accurate and reliable . . . can be depended upon even during station power failure because it uses the dc bus for its power source. An alarm system operates until the order is returned correctly. Five or ten inch semi-flush dials for switchboard mounting. Use it to transmit orders between switchboard and turbine room.

Automatic Speed Control for Boiler Draft Fans



Draft fans operate at exactly the required speed for perfect combustion when Allis-Chalmers Type 257 Liquid Rheostats are used with wound rotor drive motors. They are application engineered to provide straight line speed characteristics . . . automatic wide range stepless speed control. Use electric, pneumatic or hydraulic pilot devices. Ask for leaflet 14S7544.

...with Power readers...

what they think of the 'more' Power

BEGINS ON PAGE 5

POWER. Merger only means POWER is twice as good now.

Chicago, Ill. EDWARD G WELLING
Engineer, John Mohr & Sons

"MORE FOR LESS MONEY" . . .

From the reader's standpoint of getting more magazine for less money, I'm very pleased with the merger. POWER is now the best and most informative magazine for industry that I know of.

San Francisco J S MELVILLE
Mech Engr, C C Moore & Co

You are to be complimented for the foresight to combine *OE* and POWER. Design and operation are inseparable. I enjoy combined magazine much better.

E J RAUSHENBERGER
Washington, D. C.
Head, Internal-Combustion Plants, REA

Long-time readers glad . . .

I have been a reader of POWER for over 25 years. It has always been tops, but now you have made it better. I think it is fine. What more can you do?

Shelby, Mont. M B CHANDLER
Chief Engr, Marias River Elec Co-op

(*Watch next month . . . and future months, Mr. Chandler!*—Ed.)

It was hard to beat POWER as such. I've been a subscriber since 1911. Merger hasn't detracted, but produced a wonderful combination, in addition to one less magazine around the home.

Holyoke, Mass. R A PACKARD
Consulting Engr

I have been a POWER subscriber for the past 18 years and of *OE* since first issued. There are no better engineering magazines for operating and maintenance men.

Pittsburgh, Pa. ROBERT H WILSON
General Foreman of Utilities
Jones & Laughlin Steel Corp

Have been a POWER fan for some time. Our company also subscribed to *OE*, which I read every month. Good deal!

Houston, Texas W O HOLLOWAY JR
Tennessee Gas Transmission Co

How it hits consultants . . .

We like the "New Deal" very much. The writer is only a practical engineer with 50-odd years of practice. Junior member of firm is a professional engineer. We both approve the merger as a real help to the readers of POWER.

Los Angeles, Calif. W E CARR
Mgr, W E Carr & Son

A step in the wrong direction as far as its usefulness is concerned. You should keep the two separate.

New York, N. Y. SABIN CROCKER
Mech Engr, Ebasco Services, Inc

Seldom in these times does one get more in a package and then discover that it costs less money. We are genuinely pleased with the broader scope of POWER. Just as you've given more POWER to us, we say MORE power to you!

South Bend, Ind. PAUL J GROGAN
Asst Prof, Univ of Notre Dame

A decided improvement. Operating subjects are of interest and value to professional and technical people, and professional material to operators.

New York, N. Y. C G LOHDEN
Senior Mech Engr, Ebasco Services, Inc

In my opinion the merger has increased the value. It has always been my belief that broadcasting operating and practical facts of plant and building equipment through the medium of a magazine like POWER is a real help to all operating men and to designers of plants and machinery. Busy men should appreciate the work and thought your organization puts into each issue.

New York, N. Y. STANLEY F DAVIES
Kaiser, Muller & Davies

Industry votes "yes" . . .

Fine! It gives me the things we want in one publication. We get a lot of good ideas from it.

Parkersburg, W. Va. H C MCEWEN
Power Supvr, E I DuPont & Co

I think the merger is a good idea because: (1) as a management man, my interest is chiefly on the "professional" side, but at the same time I want to keep informed about good operating techniques (2) the men who operate our power dept are chiefly interested in the *OE* material but I want them to be familiar with the management side also, so they'll be fitted for upgrading.

Indiana, Pa. F C RANKIN
Factory Supt, McCreary Tire & Rubber

A very complete, informative magazine, just what all power engineers need . . .

Marietta, Ohio L A MORRIS
Optg Supvr, Calco Chemicals Div

In these days of constantly rising prices, when every trip to the grocery finds foods a few cents higher, and clothes, shoes, cigarettes, whiskey and all the other necessities of life in a seemingly endless rise, it's a shock to find someone offering more for less money.

Combining POWER and *OE* is a very good move and tends to bring the technical and practical engineers closer together. The thing I'm going to keep a close watch on is the amount of space allotted to operation and maintenance. If that space shrinks you will hear from me. And if Marmaduke gets disgusted with his highbrow surroundings and gets off on the dock, I'm going with him. I think, however, that you're too smart to let either happen.

Plymouth, Mich. J E GLEASON
Engr, Evans Products Co

(*Marmaduke is too ornery to let us let it.*—Ed.)

Most utility men agree . . .

By putting both magazines together you have achieved the ultimate in organization. Not only does it bring all the articles together, but it brings all the advertising together where it can be compared and studied.

Longview, Texas JOHN HAYTER
Mech Engr, Southwestern Gas & Elec

Improves scope of magazine; it is therefore of particular advantage where magazine is passed on to many different persons.

San Diego, Calif. C L HATHAWAY
Supt Elec Prod, San Diego Gas & Elec

There was no clear-cut line of demarcation between the fields covered by the two papers. . . . A single publication saves me the necessity of reading both and covers the field more thoroughly.

Los Angeles, Calif. H T LIVINGSTON
Mech Engr, Dept of Water & Light

I think they should have been left separate.

McKinney, Texas O F MCCALLUM
Plant Supt, Texas Power & Light Co

It increases value of POWER to me because about 30% of my problems involve operation.

Lawton, Okla. E G HOBBS
Mtce Engr, Public Service Co of Okla.

Excellent idea! It's good for the "professionals" to know which end of a wrench to grab hold of.

Dixon, Ill. W H GUPPY
Eff'y Engr, Public Service Co, N. Ill.

For other slants . . .

on the "more" POWER, turn to p 111 where Phil Swain takes a state-by-state tour.

Even with these, we've only given you a sample of the hundreds of letters—and they're still coming! Our only regret is that we haven't been able to keep pace with our acknowledgments. If you haven't had a "thank you" yet, stick with us—we're doing our best!

now

an integral-furnace boiler

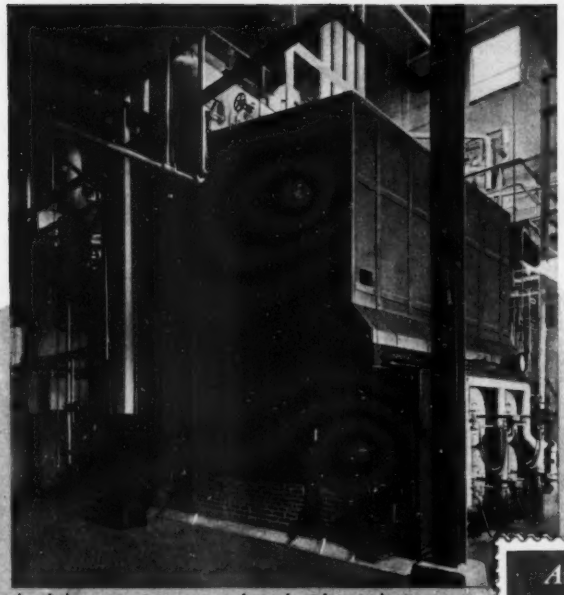
for 30,000—70,000 lb. steam per hr.

TYPE FJ SAVES:

- fuel
- maintenance
- space

Integral-Furnace Boiler, Type FJ, arranged for stoker firing.

BABCOCK & WILCOX



This oil fired unit in an eastern processing plant is rated at 55,000 lb. steam per hr. . . . readily carries highly variable load without fluctuation of pressure.

Another Example of B&W Engineering for Economy

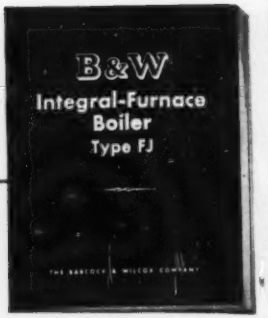
The Integral-Furnace Boiler, Type FJ is a recent addition to B&W's line of completely coordinated furnace-boiler steam-generators. It makes available a compact, highly efficient installation to answer all process, heating, or power requirements from 30,000 to 70,000 lb. per hr.

Complete fuel-flexibility — coal, oil, or gas, with a choice of alternative firing arrangements — protects the investor against radical changes in fuel prices or conditions of supply. This unit burns a wide variety of fuels — including those of inferior grades and low-temperature ash-fusion characteristics — with high heat-rate efficiency, low maintenance, and minimum stack emission.

It lends itself admirably to pressure-furnace operation with consequent reduction or elimination of ID fans. And where suction operation is used, the low draft-loss design keeps ID requirements to a minimum.

Unusually wide leeway in water-level and allowable boiler-water concentration is provided by the large drum and efficient cyclone steam separation system . . . which also contribute to ease in meeting sudden and severe load swings.

This unit incorporates all the advantages of Integral-Furnace design, which has proved so successful since its introduction by B&W in 1933. The popular Integral-Furnace "Family" now includes Types FH, FL, FJ, FF, and Shop-Assembled FM Units—spanning a range of steam-capacity now available from 2,800 to 350,000 lb. per hr.



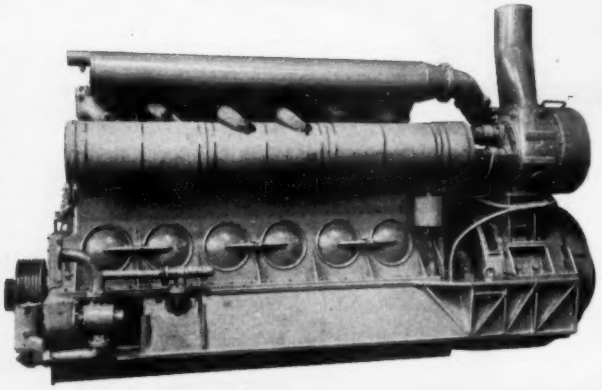
Complete details of construction and operating advantages of the Integral-Furnace Boiler, Type FJ are included in new Bulletin G-70, available upon request from the Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

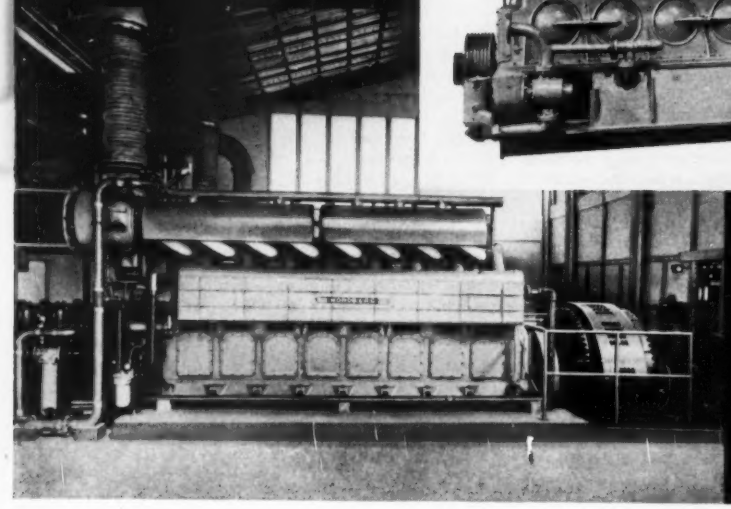
Improved ELLIOTT TURBOCHARGERS

... deliver all the air pressure any diesel can use!

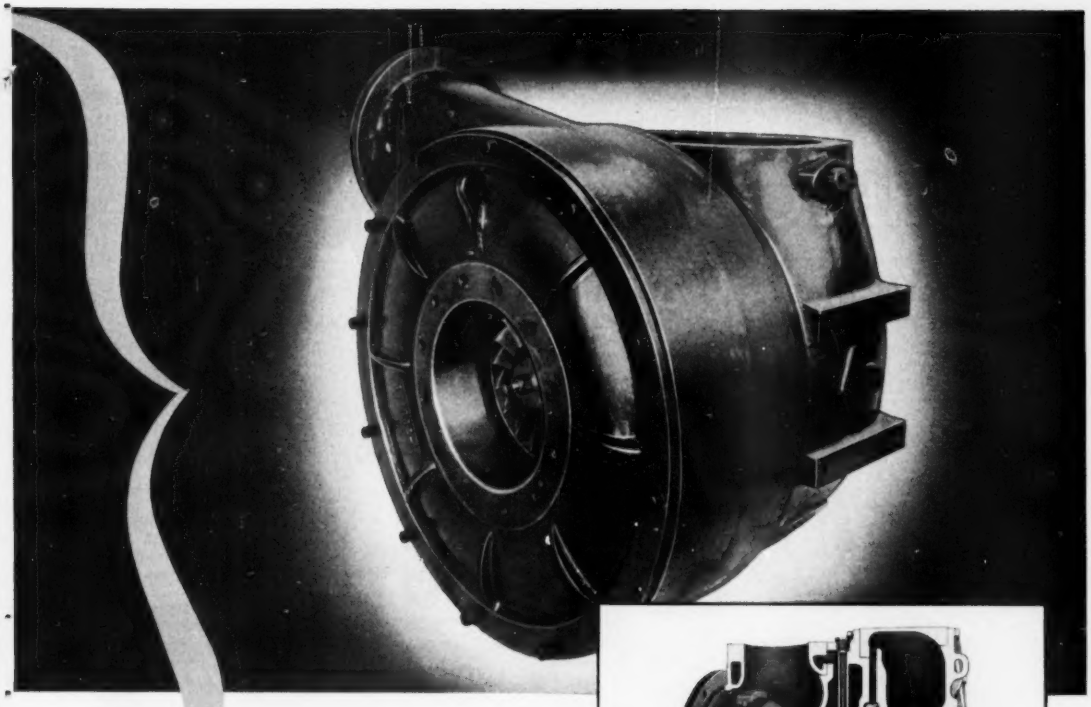
On a 1200-hp Baldwin engine for locomotive service.

As applied on a 2100-hp 327-rpm 8-cylinder Nordberg engine installation.



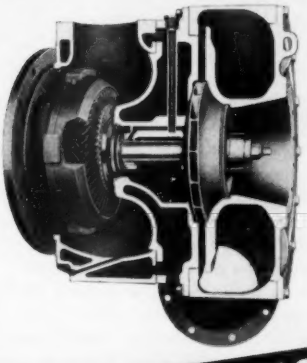


HALF CENTURY OF POWER PROGRESS
1901 1951



Elliott-built turbochargers are now operating on engines, the combined output of which exceeds 6,000,000 bhp. They are accepted and utilized by every builder of slow-speed, heavy-duty four-cycle Diesels, 250 hp and up, in the United States.

Now developed in two types, for high and low pressure, the new Elliott line of turbochargers profits by Elliott engineers' experience of the past ten years in the design and manufacture of these units. The new high-pressure design can deliver blower pressures up to 20 psi, permitting up to 170 bmep in the cylinder. The new line is built in sizes for engines up to 3500 hp. Units can be supplied for a variety of mounting and piping arrangements, and various assembly positions of turbine inlet and blower discharge.



ADVANTAGES

- Engine output increased up to 100%—
- Increased overload capacity—
- Constant torque at reduced speeds—
- Reduced consumption of fuel and lube oil—
- Operation unaffected by reversing engine.

ELLIOTT COMPANY

Supercharger Dept.* • *Jeannette, Pa.

PLANTS AT: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

M-104

An Immutable Law of Nature

Assures

CORRECT WATER LEVEL READING

DIAMOND

BI-COLOR WATER GAUGE

An unvarying law of nature . . . the difference in refraction between water and steam . . . assures correct water level indication in the Diamond Bi-Color Water Gauge.

Red and green light are directed through the gauge glass. The water refracts the red light out of sight . . . so water always shows green. Steam refracts the green light out of sight . . . so steam always shows red. The junction of the red and green is always the exact water level. The contrast is unmistakable . . . **and there is no guessing whether the glass is full or empty.** There are no moving parts or linkages . . . and no time lag.

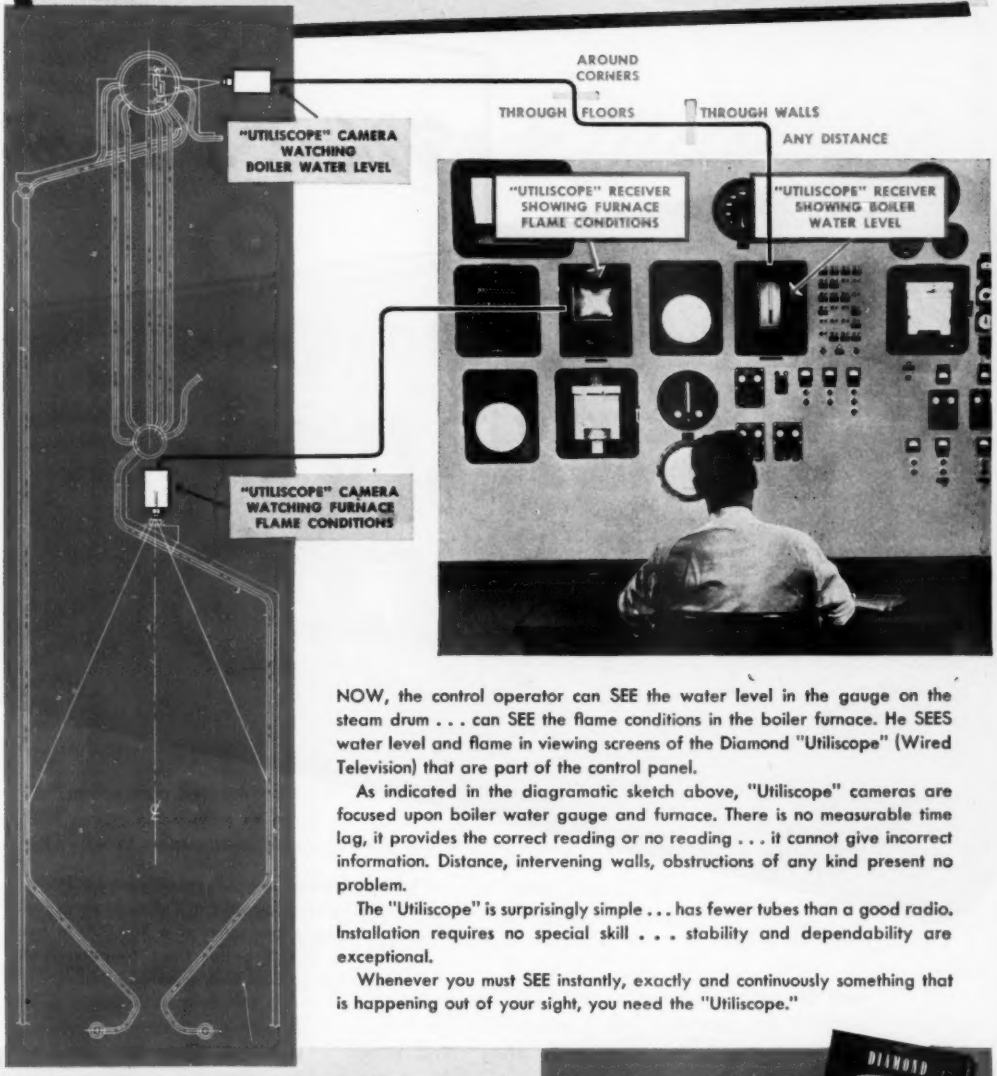
The Bi-Color image is so clear that it can be mirrored from any reasonable height* and through three grating levels to the firing floor without confusion. It can be easily substituted for most existing water gauges, whether of Diamond or other manufacture. Ask for Bulletin 1015.

*Where distance is greater than approximately 100 ft and multiple mirrors are required, or where the cost of keeping the light path clear of obstructions is a factor, the addition of a Diamond "Utiliscope" is recommended. See Bulletin 1025.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • *Windsor, Ontario*

Write for **Bulletin No. 1015**

The "UTILISCOPE" (WIRED TELEVISION) Brings REALISM to Centralized Control


AROUND CORNERS
THROUGH FLOORS
THROUGH WALLS
ANY DISTANCE
"UTILISCOPE" CAMERA WATCHING BOILER WATER LEVEL
"UTILISCOPE" RECEIVER SHOWING FURNACE FLAME CONDITIONS
"UTILISCOPE" RECEIVER SHOWING BOILER WATER LEVEL
"UTILISCOPE" CAMERA WATCHING FURNACE FLAME CONDITIONS

NOW, the control operator can SEE the water level in the gauge on the steam drum . . . can SEE the flame conditions in the boiler furnace. He SEES water level and flame in viewing screens of the Diamond "Utiliscope" (Wired Television) that are part of the control panel.

As indicated in the diagramatic sketch above, "Utiliscope" cameras are focused upon boiler water gauge and furnace. There is no measurable time lag, it provides the correct reading or no reading . . . it cannot give incorrect information. Distance, intervening walls, obstructions of any kind present no problem.

The "Utiliscope" is surprisingly simple . . . has fewer tubes than a good radio. Installation requires no special skill . . . stability and dependability are exceptional.

Whenever you must SEE instantly, exactly and continuously something that is happening out of your sight, you need the "Utiliscope."

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

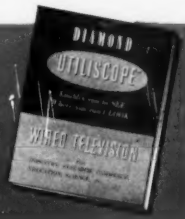
The "UTILISCOPE"—First in Industrial Television

Diamond Specialty Limited — Windsor, Ontario

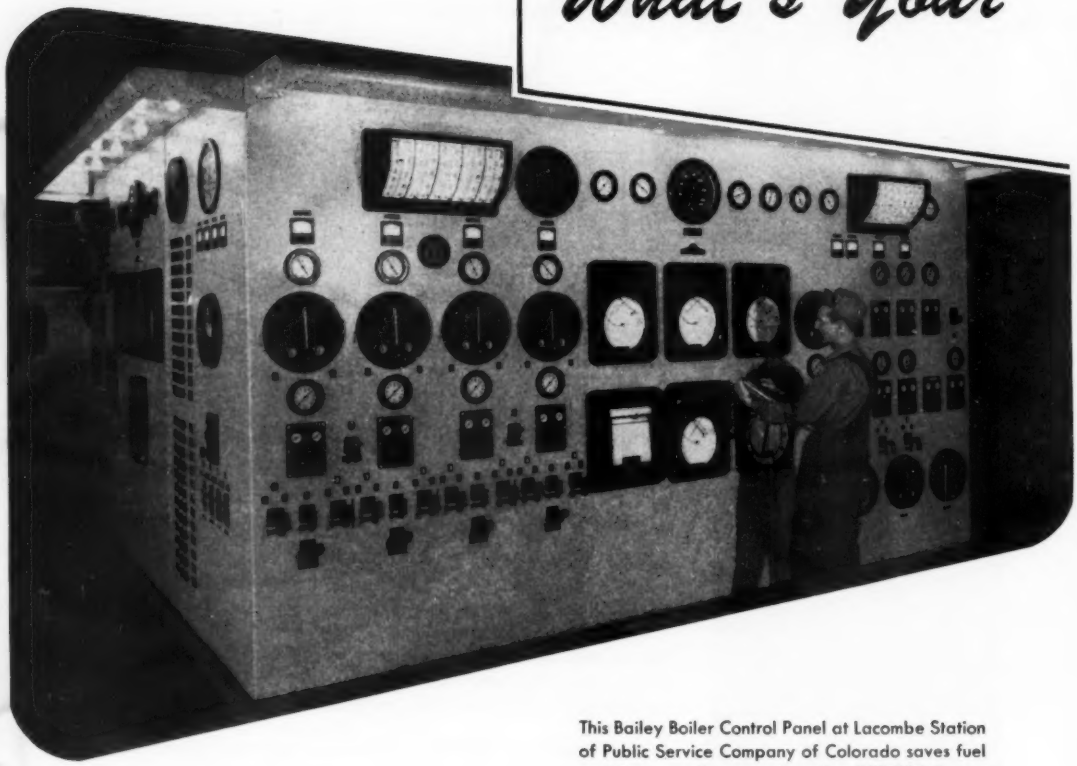
The "UTILISCOPE" (Reg. U. S. Patent Office)

WRITE FOR BULLETIN 1025

with complete descriptions; it suggests many other possible uses.



What's Your



This Bailey Boiler Control Panel at Lacombe Station of Public Service Company of Colorado saves fuel and insures safe operation of a 350,000 lb per hr 850 psi, 900 F boiler fired by pulverized Colorado Lignite Coal and/or natural gas.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Control-Dollar Efficiency ?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you. Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better control-dollar efficiency—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-2

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

Here's the AUTOMATIC *at* PALATKA *of* FLORIDA POWER &

Standing at the central control panel, the operator will need only push a single button to start the automatic sequence. He can see at a glance that each blower operates in correct sequence, cutting in automatically to blow for the right length of time with the required steam flow and pressure. He can skip or repeat operation of individual blowers as needed without leaving the panel.

Effective boiler cleaning and low cleaning costs were demanded for the new Palatka Steam Electric Station of Florida Power & Light Company. Vulcan will deliver these benefits.

Effective boiler cleaning will be a simple matter of pushing a single button to start operation of the automatic-sequential soot blowing system. Each blower will work in the correct sequence, applying the right amount of steam at the velocity needed for thorough cleaning.

Steam will be saved, because each blower will operate for exactly the correct time. Labor will be saved, because operators will not need to climb to remote locations when they blow soot. Maintenance costs will be low, because each Vulcan unit is designed and built for easy inspection and repair or replacement, if needed.

Vulcan Automatic-Sequential Soot Blowing is described in Bulletin 483. Write for it. Learn how you can profit from advanced Vulcan designs.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DU BOIS, PENNSYLVANIA

VULCAN *Automatic*

VULCAN

SEQUENTIAL SOOT BLOWING SYSTEM

STATION

LIGHT COMPANY

Boiler by.....Combustion Engineering—Superheater, Inc.

•

Type of Boiler.....VUX

•

Capacity.350,000 lb per hr

•

Operating Pressure.850 psi

•

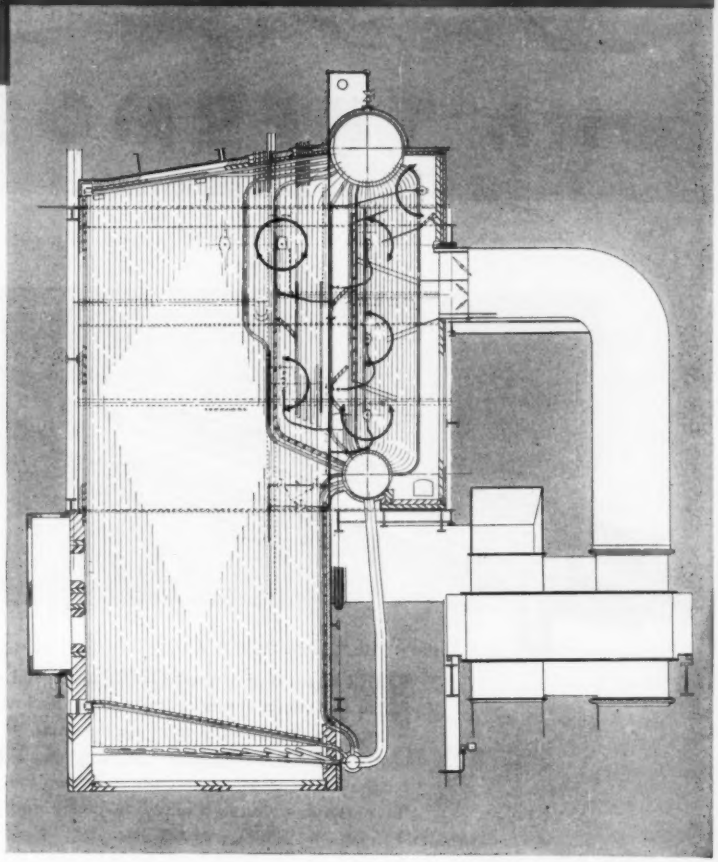
Total Steam Temperature .....900° F

•

Fired with.....Oil, with provision for future use of coal

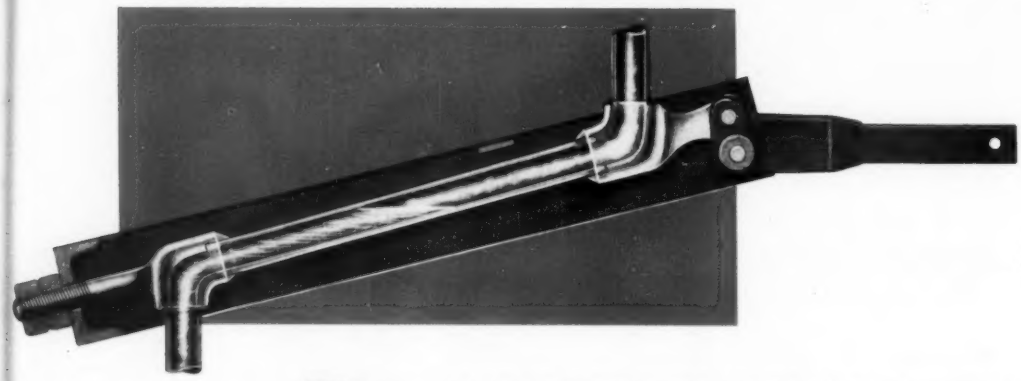
•

Consulting Engineers..... Ebasco Services, Incorporated



The Vulcan Soot Blower System includes two long retractable blowers and ten VULcomatic rotary units, air-powered, under full automatic-sequential control. Blowing medium is steam taken from the saturated drum and reduced to 600 psi without a relief valve.

COPES with THERMOSTATIC



THE upper end of the COPES Thermostat, a special-alloy tube, is connected to the steam space of the boiler; the lower end to the water space. Thus, water level in the tube must be the same as in the boiler drum. As the level lowers, more steam enters the tube, which must expand. As the level rises, condensate cooled by radiation enters the tube, which must contract. This thermostatic action is positive, accurate and geared to the boiler water level.

COPES

BOILER FEED

was FIRST
Feed Water Regulation

WHAT more positive force could you want to move a valve than that created by expansion and contraction of metal subjected to temperature changes? That was the reason COPES in 1898 first used a thermostatic tube to actuate a feed water regulator valve.

No other actuating element has ever produced the same great, positive force to position the feed valve. That is why so many important boilers are today equipped with COPES Thermostatic Feed Water Regulators—for greater safety—for more efficient, more economical feed-flow and water-level control. There is an installation near you. Check it yourself, to see what results users expect—*and get*—with COPES.

NORTHERN EQUIPMENT DIVISION

Continental Foundry & Machine Company

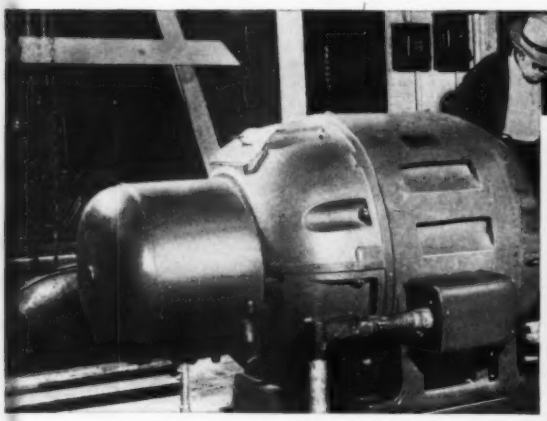
611 GROVE DRIVE, ERIE, PENNSYLVANIA

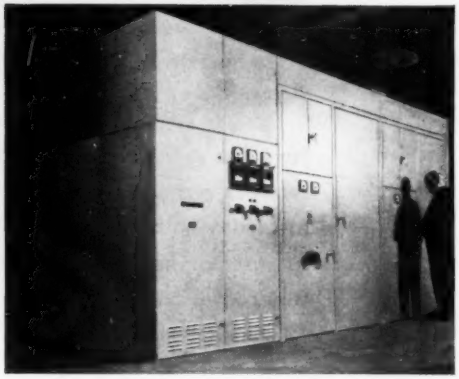
***Headquarters for* Feed Water Regulators, Pump Governors, Differential Valves, Level Controls, Hi-Low Alarms, Reducing Valves, Desuperheaters**

WATER REGULATION

DEPENDABILITY where it counts

SYNCHRONOUS MOTORS

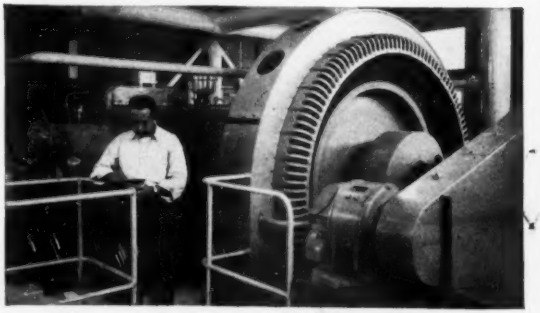




Dependability and long life are a must in water-pumping equipment. Cohoes, N. Y. selected a G-E Tri-Clad* 500-hp synchronous motor for their raw-water pumping station. And as protection against a short-circuit capacity of 60,000 kva, Cohoes selected G-E Limitamp high-voltage control. Besides providing accurate control for the motor, Limitamp clears shorts from the line in less than half a cycle—before damage can come to either motor or control. Ask your nearest G-E sales office for more information on Limitamp control.

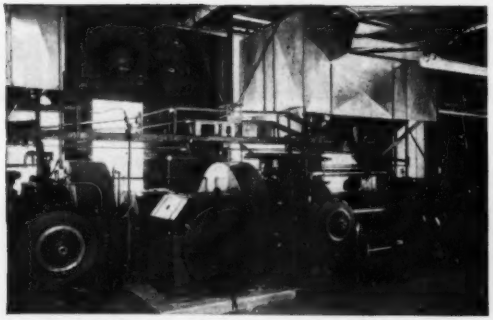
*Reg. U. S. Pat. Off.

ON CRITICAL PUMPING OPERATIONS

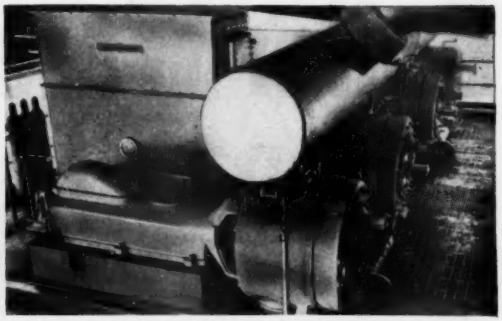


Driving compressors in gas pumping station serving hundreds of homes, motor requirements were—dependability and low cost. This G-E 1500-hp synchronous motor scores on both counts.

FOR SPECIAL SERVICE CONDITIONS

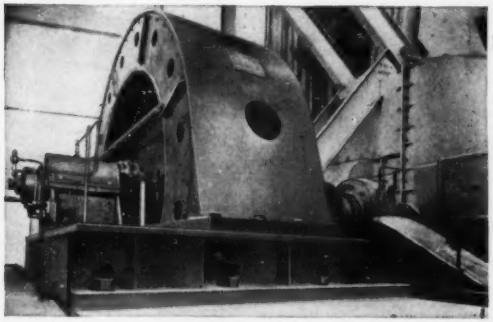


Corrosive, dust-laden atmosphere has no effect on this externally ventilated synchronous motor. Installed in a plastics mill, it's typical of the special enclosures that can be designed to meet almost any operating problem.

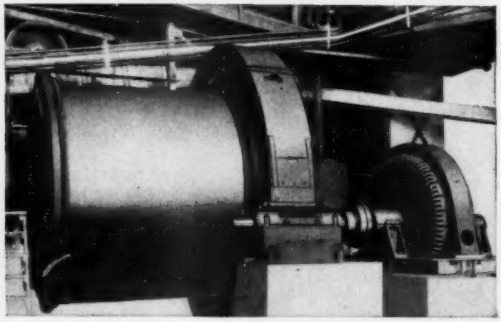


These gas compressors created a hazardous atmosphere for motor operation. The external enclosure of this 300-hp, G-E synchronous motor is filled with an inert gas to provide reliable operation.

FOR TOUGH JOBS



A motor must be rugged to drive a large wood chipper capable of chewing 40-inch diameter logs into small pieces. This G-E synchronous motor, with rigid, box-type construction will give years of dependable service—on a *tough* application.



To meet the rough test of driving a ball mill, this mining company chose a G-E high-torque synchronous motor rated at 600 hp. It's given them years of dependable operation and still going strong.

SAVE MONEY, TOO

It's a fact . . .

Lower Operating Costs,
higher operating efficiency.

Lower Initial Cost
including control and exciter—for many ratings.

Reduced Demand
and release of needed generating capacity.

Reduced Power Rates
for improved power factor.

Application engineers, with many years of field experience, will tailor G-E synchronous motors and control to *your* job. And, no matter where you are located, there's a G-E Service Shop near you.

For your next large, synchronous motor application, call in your General Electric representative—he'll be glad to discuss with you, your particular application. For more information on G-E synchronous motors, write for GEA-5332 (low-speed) or GEA-5426 (High-speed) to: *Section 770-24, General Electric Company, Schenectady 5, New York.*

You can put your confidence in—

GENERAL ELECTRIC

770-24

Boiler Water Indication

AT THE BOILER DRUM
YARWAY FLOATLESS HI-LO ALARM WATER COLUMN with VERTICAL PRESSURE-SEALED FLAT GLASS GAGES. Glass gages have patented "floating assembly" that reduces glass breakage and leakage. See Bulletin WG-1811.
YARWAY
H
L
YARNALL-WARING CO.
PHILADELPHIA, PA.
PATENT APPLIED FOR

YARWAY

ON THE LEVEL with a Yarway System

It's accurate! It's where you can see it!

These two most important needs for boiler water level indication are assured with a Yarway system.

Yarway indicating equipment is accurate because it is *operated directly by the boiler water itself.* Yarway Weight-operated Hi-Lo Alarm Water Columns with either Seaure Inclined or Flat Glass Vertical Gages take care of the job at the boiler drum. On the instrument panel or other desired location, Yarway Remote Liquid Level Indicators bring overhead gage readings down to convenient, easy eye-level vision. By use of a Control Unit on the indicator, additional Hi-Lo light or sound alarms can be located at any place in the plant.

The Yarway HI-LO-GRAPH, a panel-mounted *recording* indicator, gives a 24-hour record of boiler water levels.

Yarway engineers will gladly show you how the Yarway Boiler Water Indicating System increases power plant *safety* and *efficiency.*

For the full story on Yarway Indicators, write for a free copy of Yarway Bulletin WG-1822.

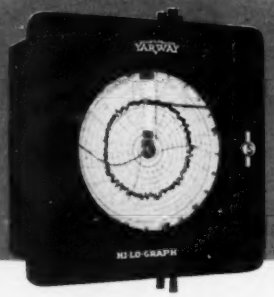
YARNALL-WARING COMPANY, 100 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

ON THE INSTRUMENT PANEL

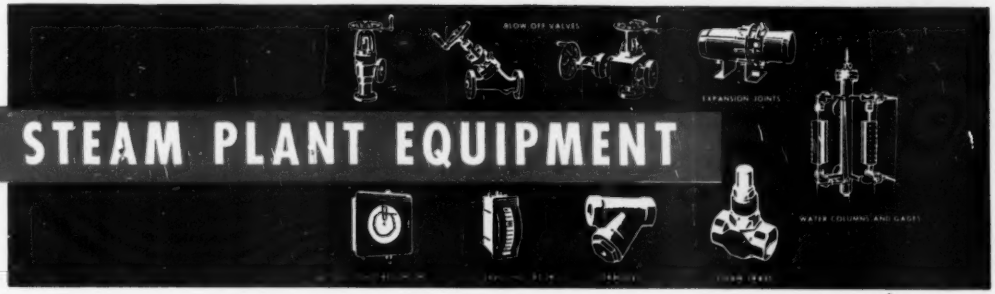
YARWAY REMOTE LIQUID LEVEL INDICATOR, operated directly by the boiler water itself, by the pressure differential between a constant head and the varying head in the boiler drum. Indicating mechanism is never under pressure—no stuffing boxes. See Bulletin WG-1822.

YARWAY HI-LO-GRAPH RECORDER provides not only instant indication but also 24-hour recording of boiler water levels. See Bulletin WG-1830.



ANYWHERE IN THE PLANT

YARWAY REMOTE HI-LO ALARM SIGNALS, lights or horns. Operated by Control Unit attached to Remote Liquid Level Indicator or Recorder. Any number can be installed, at any desired locations throughout the plant. See Bulletin WG-1822.



Get Full Electrical

WITH MECHANICALLY TRIP-FREE PNEUMATIC OPERATION

YOUR CIRCUIT BREAKER is a long term investment that pays dividends daily in protection for your electrical system. Naturally, you want full electrical protection — the best protection your money can buy. That's an important reason why your pneumatically operated circuit breakers should be mechanically trip-free. Unless they're mechanically trip-free they may fail to reopen properly when closed against a fault condition.

TRIP-FREE ADVANTAGES

Opening action of Allis-Chalmers pneumatically operated breakers is immediate and positive, because tripping instantly uncouples contacts from the closing mechanism. Opening occurs whether the breaker is in normal closed position or is "closing in" on a short circuit.

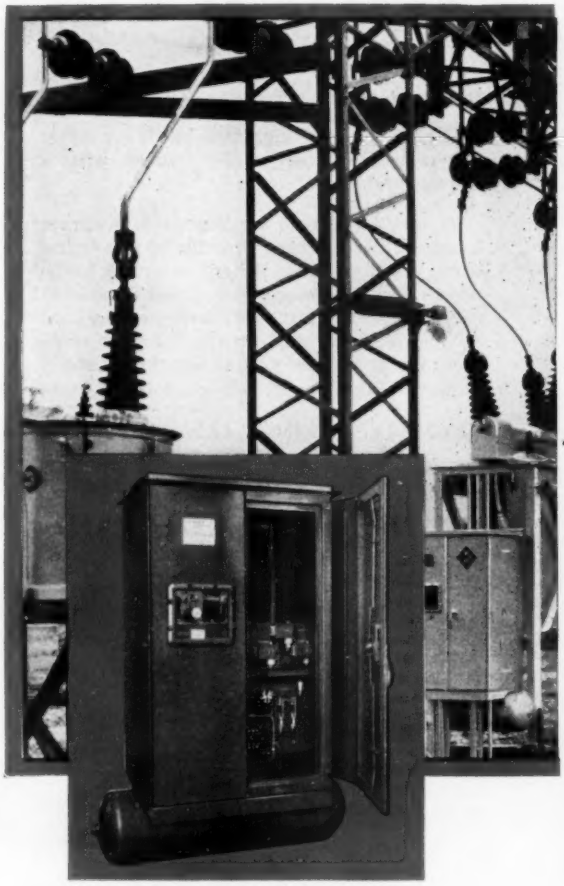
Breaker opening is independent of the closing piston and air valves. There is no drag from the closing mechanism.

Designed for high speed (20 cycle) reclosing, these breakers combine fast acting power of pneumatic operation with fast recoupling of contacts and reclosing mechanism. Stored energy for fast closing comes from a self contained air pressure tank with compressor.

You can gain the advantages of mechanically trip-free operation in every Allis-Chalmers power oil circuit breaker — whether pneumatically, solenoid or manually operated. It is standard in all sizes and ratings.

More than one-half century of experience stands behind the dependable operation of these breakers, serving industry since 1899. This dependability is being proved daily in utility and industrial installations coast to coast.

Call your Allis-Chalmers district office for more information on power oil circuit breakers. Or write Allis-Chalmers, Milwaukee 1, Wis., for your copy of the mechanically trip-free pneumatic operator bulletin. A-3355

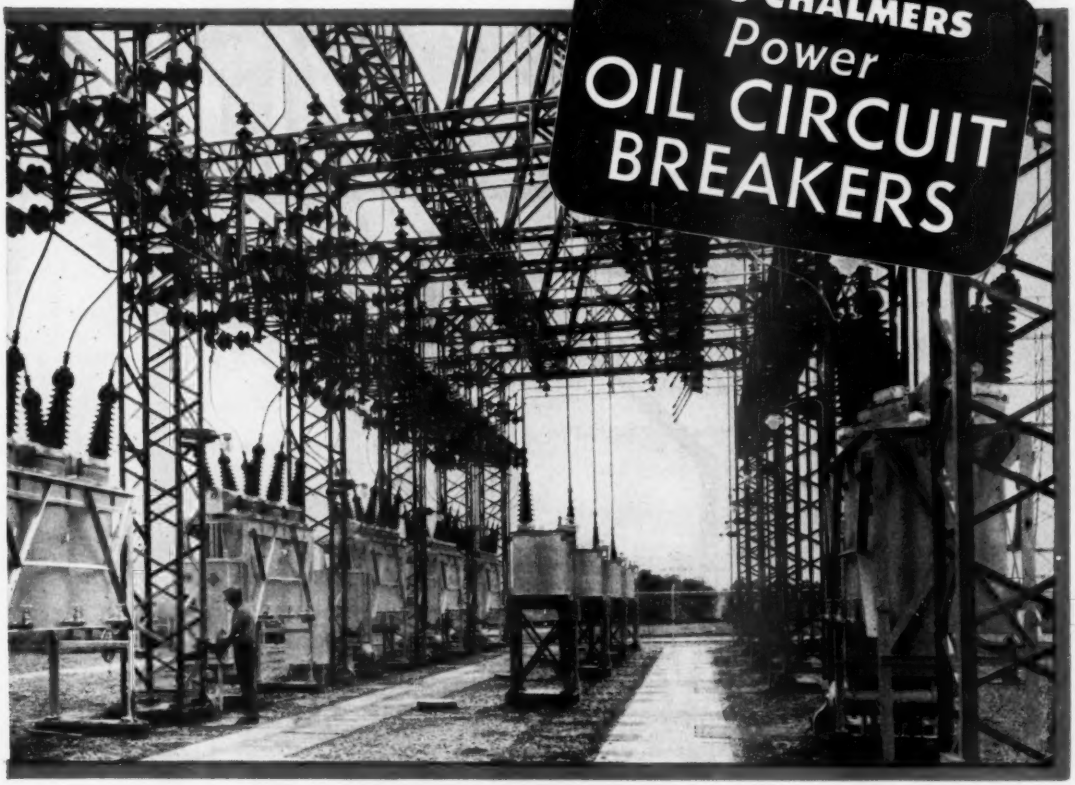


Weatherproof operator housing furnishes double protection against moisture.

For keeping out wind-driven weather, double doors with full length hinges are recessed. They have provisions for gasketing. The large safety glass window in the door permits a quick check of air pressure gauge, position indicator, operation counter and nameplate.

The operator is protected against condensation. The air tank is outside of housing. Thermostat controlled electric heaters keep both the operator and housing interior above ambient temperature. All parts are rustproof.

Protection



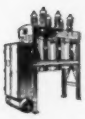
These FZO-151 circuit breakers are equipped with the reliable mechanically trip-free pneumatic operator. The *Ruptor* interrupting device and many other important features also contribute to your assurance of positive operation. The FZO-151 is rated 69 kv up to 3,500,000 kva with 8 to 5 cycle opening, 20 cycle reclosing.

Ruptor and *Unitop* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

MECHANICALLY TRIP-FREE PNEUMATIC OPERATOR IS STANDARD EQUIPMENT ON ALL THESE ALLIS-CHALMERS OUTDOOR POWER OIL CIRCUIT BREAKERS



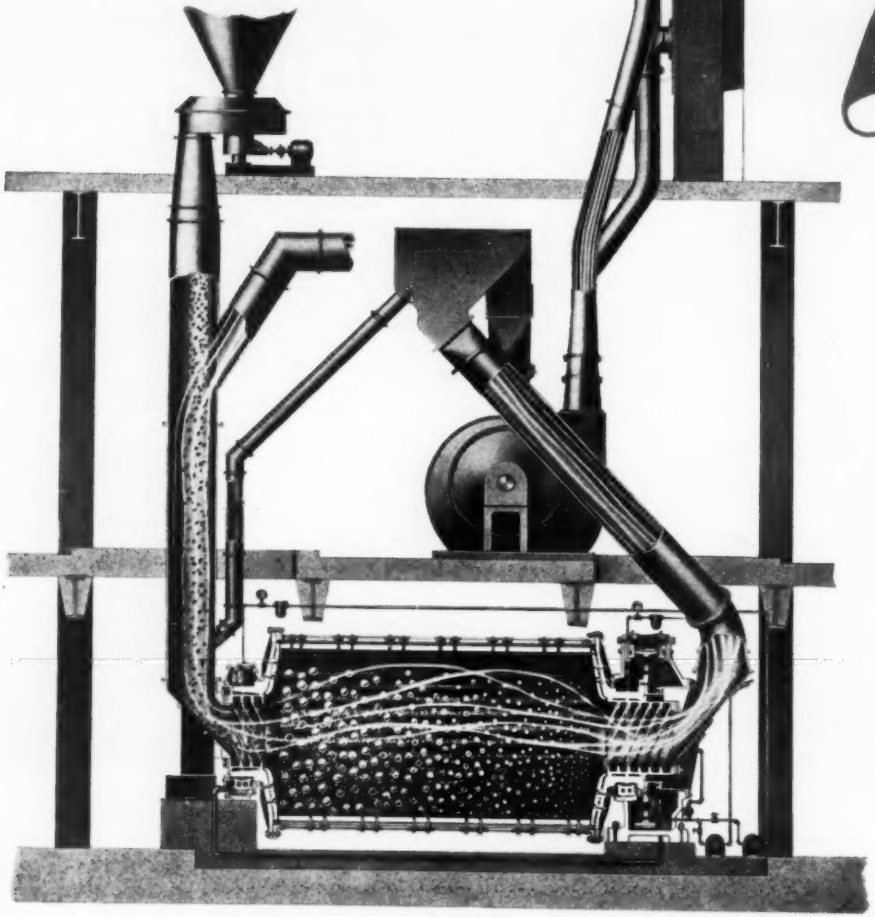
Type FZO-150 *Unitop* breaker 14.4 to 46 kv, 8-cycle opening, 20-cycle reclosing*

Type FZO-151 . . . 69 kv, 5 or 8-cycle opening, 20-cycle reclosing*

Type BZO-160 . . . 69 kv, 8-cycle opening, 115 to 230 kv — 3 or 5-cycle operating with 20-cycle reclosing*

*20-cycle reclosing standard for 600 and 1200 amp breakers

Instant Response to



Combustion Controls with KVS Pulverized COAL FIRING

KVS Pulverized Coal Firing results in worthwhile savings on your fuel bill.

. . . Complete and rapid combustion through extremely fine pulverization are assured by the KVS Air Swept Tube Mill.

. . . unburnt carbon losses are less than one-half of one percent at all ratings.

. . . pulverized coal is available for full capacity requirements on instant demand.

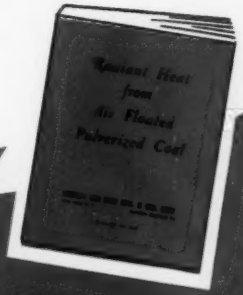
. . . load changes do not affect high efficiency.

KVS pulverized coal equipment is unusually free from service shut-downs. Continuous year-to-year, uninterrupted operation is common practice in large KVS-equipped power plants. It is unnecessary to shut down KVS Air Swept Tube Mills when adding balls for grinding. Investigate *all* the advantages of KVS pulverized coal fired steam generators before writing specifications.

KVS ENGINEERING SERVICE

Our engineers will furnish complete boiler designs for your steam requirements. Let us help you reduce your operating and fuel costs with KVS pulverized coal firing and KVS steam generators.

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.



Kennedy Products — Kennedy-Van Saun Mfg. & Eng. Corp. — New York, U.S.A. — Quality Service

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

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THE MUNICIPAL ELECTRIC PLANT
of MUSCATINE, IOWA

Knows the Value of *Automatic*

Republic automatic boiler control and instrument panels at Muscatine Municipal Electric Plant

Republic regulator controlling fuel feed to stokers.

Control

● In 1941 the Municipal Electric Plant at Muscatine, Iowa, installed a modern 100,000 lb. per hr. steam generator. In 1948 a second boiler rated at 160,000 lb. per hr., 650 psi. was added.

In any steam electric generating plant, electric power rates and steam cost go hand-in-hand. Low steam cost however, is not the result of efficient boiler design alone. It is determined by the degree with which your method of boiler control takes full advantage of those economies which have been "built-in" the boiler and its auxiliaries.

To realize all the operating advantages of these modern boilers, each was equipped with a Republic automatic combustion and feed water control system at the time of installation. Built into the Republic control system are the many important features that enable it to fulfill all the conditions of theoretically perfect boiler control and still meet all the demands of everyday operation.

The installation of Republic automatic controls on your boiler (or boilers) will enable you to: —

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hours a day, 7 days a week.

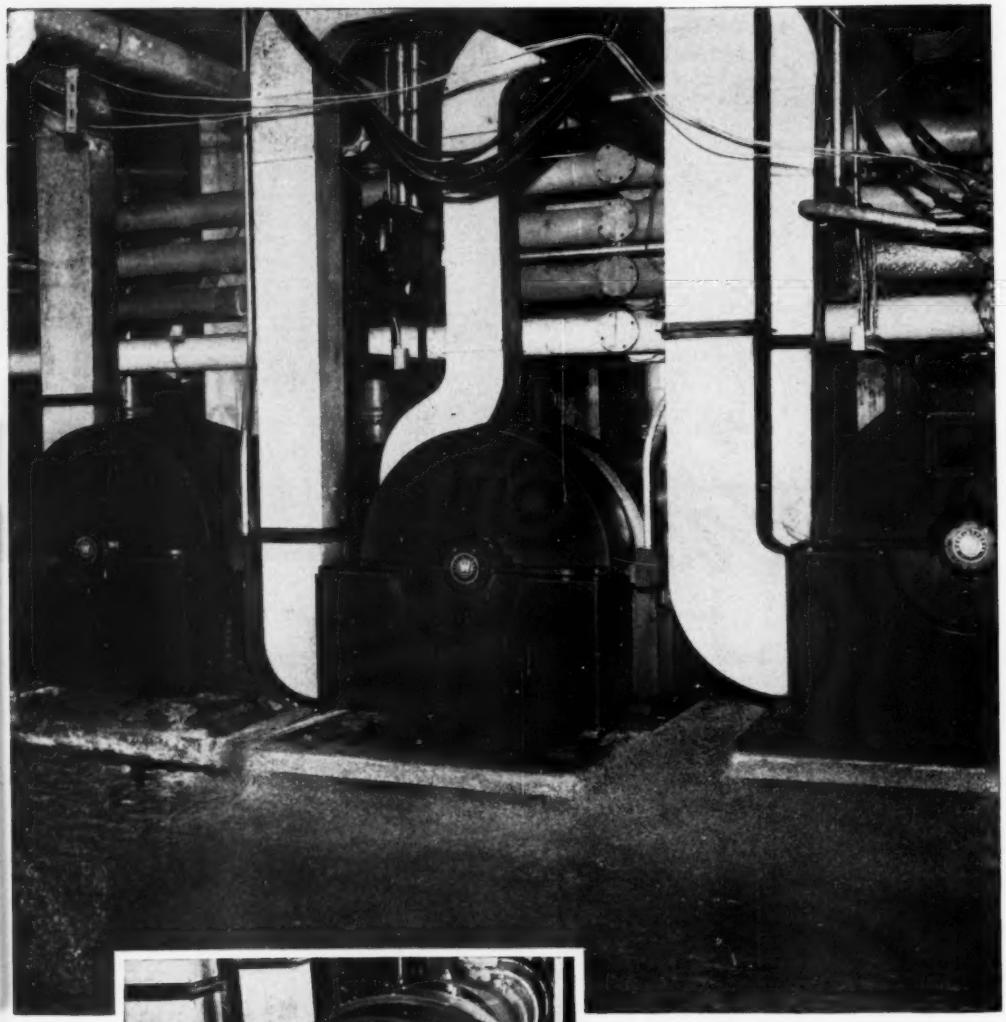
CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

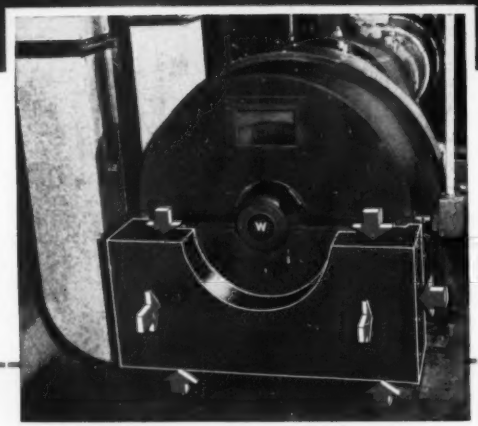
REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently develops as a result of incorrect boiler operation.

An automatic boiler control system, as designed and built by Republic, will help you meet today's need for more steam at lower cost.

Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY ● CHICAGO 47, ILLINOIS





The above is a typical forced-ventilated installation. These same ducts could have been brought into these motors from any angle as shown by the arrows on the inset at the left.

WHERE FORCED VENTILATION IS REQUIRED . . .

Westinghouse Air Inlet Brackets Offer Complete Flexibility of Installation

From the top, bottom, front or either side . . . ventilating ducts or pipes may be brought in from practically any angle to this forced-ventilated, large induction motor. It's the ventilation system and design of the air inlet brackets that make this possible.

Ventilating air is supplied to the motor from both ends through the two air inlet brackets. These brackets can be supplied with duct or pipe connections located on any of the exposed surfaces. Thus, many installation problems are eliminated and the motor can be positioned without regard to the space available for duct work.

The ventilating air is discharged from both sides of the motor through louvered openings. If desired, these openings can also be housed so that the exhausted air can be routed away through similar ducts or pipes.

Other important Westinghouse features that you will want to consider in selecting your next large induction motor are:

Bearing construction and end enclosures make bearing inspection, cleaning, servicing and replacement as easy as on a standard open motor.

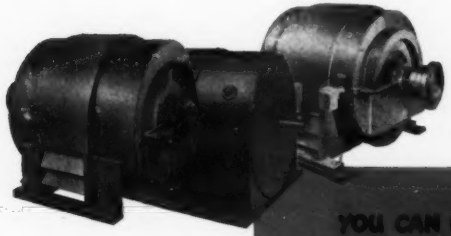
Welded steel construction to form a sturdy frame.

Insulation of great dielectric strength and high heat resistance for long life.

All-metal rotors are dynamically balanced for quiet, smooth operation.

Ask your Westinghouse representative about all the details of this improved large motor or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-10356



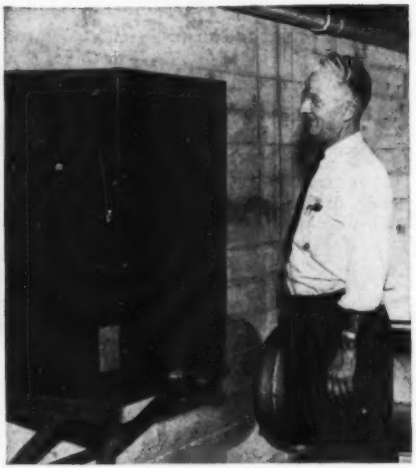
Also available are these three types of large induction motors. Open dripproof motors for general service. Outdoor motors for service in the open weather. Splashproof motors for protection against falling liquids or solid particles.

YOU CAN BE SURE . . IF IT'S Westinghouse

LARGE INDUCTION MOTORS

WITH NEW GENERAL ELECTRIC AK-3 HOOK-ON POWER-FACTOR METER YOU CAN READ P.F. DIRECT—WITHOUT BREAKING CIRCUITS.

New Instrument Helps Apply Capacitors



FEEDER CAPACITY IS INCREASED by this 60-kvar capacitor unit installed at the Los Angeles Fiber Milk Container Plant.

Get 20 to 30% more feeder capacity this simple two-step way:

- **Measure your feeder circuits with the new G-E Type AK-3 hook-on power-factor meter**
- **On circuits which have low power factor, install G-E Pyranol* capacitors**

Capacitors are one of the quickest and least-expensive ways of increasing feeder capacity. They can permanently release up to 30 per cent more electrical capacity in your power system. This extra capacity is immediately available for new lighting and motor loads; no additional transformers or distribution equipment is needed.

If your power factor is now	you can release this much extra capacity	with this many capacitors*
65%	34%	84 kvar
70%	29%	69 kvar
75%	23%	55 kvar
80%	17%	42 kvar
85%	11%	29 kvar
90%	5%	15 kvar

*For each 100 kw of load. (Power factor raised to 95%).

With the new AK-3 hook-on power-factor meter you can read power factor quickly and accurately. Then with a table like the one above, you can readily determine how much capacity you can release and how many capacitors you will need. Also, the hook-on power-factor meter helps to pin-point those feeders with low power factor—tells you where to install capacitors for maximum benefits. List price of the AK-3 is only $84.75.

For more information contact your nearest General Electric representative, agent or distributor. Or, send the coupon today.

*Reg. Trademark of General Electric Co.

General Electric Co., Section A 407-205
Schenectady 5, N. Y.

Please send me information about the following products:

( ) Type AK-3 Hook-on Power-factor Meter (GEA-5469)
( ) Pyranol Capacitors (GEA-2742)

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ADDRESS .....
CITY ..... ZONE ..... STATE .....

GENERAL ELECTRIC

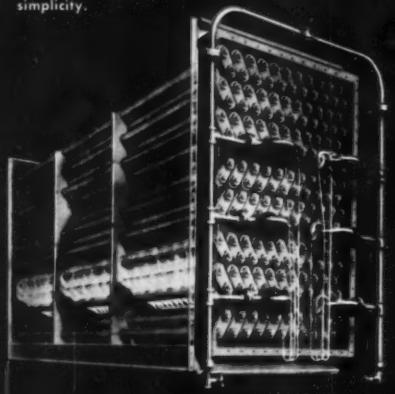
the **FUTURE**... an extension of the present

STEAM GENERATORS for every industry designed, engineered and built to meet existing and anticipated needs of a growing economy.

AUXILIARY STEAM GENERATING EQUIPMENT . . .

ECONOMIZERS

The Foster Wheeler cast-iron, extended surface, steel tube Economizer can be depended on for superior service because it is (1) corrosion resistant, (2) impervious to soot fires, (3) cleanable, and (4) unique in its simplicity.



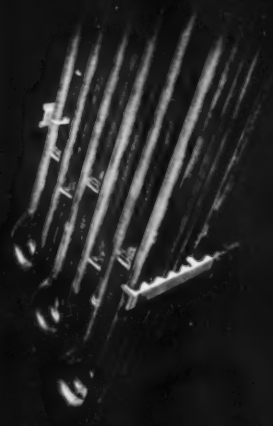
REHEATERS

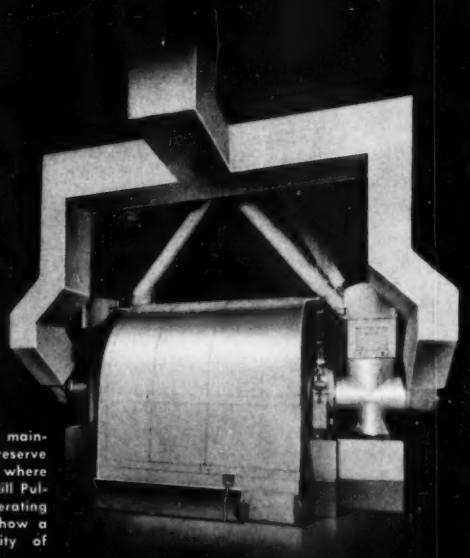
Over the past several years increased emphasis has been placed on Reheat as a means toward better station heat rate. Foster Wheeler experience in the design and fabrication of Reheaters may be measured partly by the consistently successful operation of one of the world's most efficient power stations where Foster Wheeler Radiant Reheaters and Radiant Superheaters are installed.

TUBULAR AIR HEATERS, WATER WALLS, MULTI-FUEL BURNERS, WASTE HEAT BOILERS

SUPERHEATERS

Foster Wheeler, first to develop the use of superheated steam in this country, designs, engineers, and fabricates convection and radiant type superheaters singly or in combination. SUPERHEAT CONTROL over a wide load range is also offered as a means of positive and accurate control of final temperature.



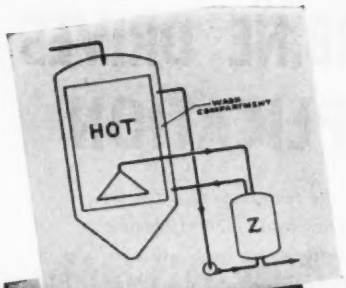


BALL MILL PULVERIZERS

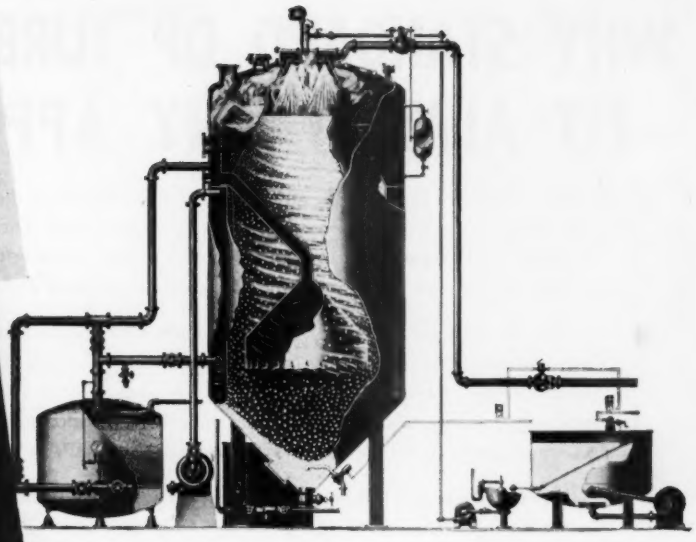
High availability, low maintenance, and large reserve capacity are assured where Foster Wheeler Ball Mill Pulverizers are used. Operating records consistently show a remarkable availability of 99% or better.

FOSTER WHEELER

FOSTER WHEELER CORPORATION · 165 BROADWAY, NEW YORK 6, N. Y.



In This
WORTHINGTON
HOT-Z
Deaerating Type Water Conditioning System . . .



Built-In Annular Wash Water Compartment Supplies and Reclaims Backwash Water

Independent of the Softening Process

No other Hot Zeolite System offers you so many advantages as this Worthington Hot-Z System. A quick review of the vital facts will show you why.

As you probably know, Hot Zeolite beds require periodic expansion to minimize packing and friction loss, and to insure efficient contact of each Zeolite particle with its share of dissolved impurities. This need for bed expansion occurs not only during the regeneration routine, but also several times during the period between regeneration routines. That's why it is important for you to use clean, softened water, preferably at normal operating temperature, for the reverse flow or "backwash" operation.

Worthington does it!

The Worthington Standard Hot-Z System with its backwash feature provides a built-in annular wash water compartment that supplies and reclaims backwash water . . independent of the system's softening process. In this compartment, backwash water is cleaned and maintained at normal operating temperature.

This backwash feature pays off particularly in systems employing filters because it *makes filter beds last as long as eight years.*

Other advantages

Worthington Hot Process Systems come equipped with modern, direct contact vent condensers. This means, no more of the scaling trouble that made the old-fashioned shell and tube types such a nuisance.

In addition, Worthington Hot-Z Systems operate on low-priced lime and salt. That's why the average installation saves enough in chemical costs to pay for itself in 3 years.

Get all the facts!

It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find in our Hot-Z System, as in so much other equipment, *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Section, Dunellen, N. J.*

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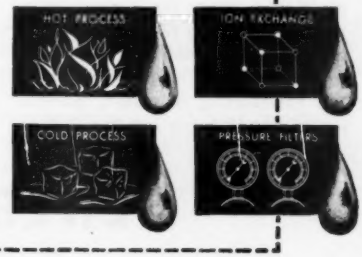
WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems

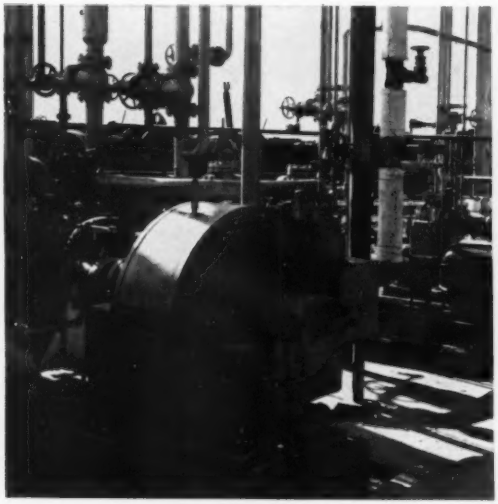


WHY STANDARD DP TURBINE DRIVES FIT ALMOST ANY APPLICATION

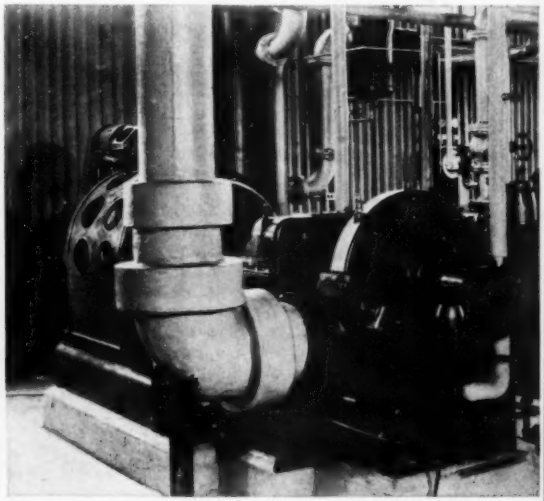
Here's a turbine designed by turbine users. It incorporates the features asked for by hundreds of operators interviewed in an exhaustive survey. They told General Electric they wanted a mechanical-drive turbine that would fit many types of applications—continuous process, standby, indoor, outdoor, equipment drive, generator drive, etc.

The DP answers these varied requirements with special features that are included as standard parts. For instance, you get hydraulic governing to meet critical accuracy requirements, totally enclosed construction that allows installation in hazardous atmospheres, pressure lubrication for dependable, continuous operation. These advantages are included at no extra cost—the DP is priced as a standard.

If you have steam available, the DP turbine can work profitably for you. You'll discover how its standard design gives you wide application flexibility, makes possible real savings in maintenance costs. The DP's operating record proves its reliability when there's a tough job to be done.



OUTDOOR INSTALLATIONS—No need to make special modifications when you move a DP out of doors. Totally enclosed governing system operating in its own oil atmosphere eliminates possibility of rusting or corrosion. You can operate a DP in hazardous atmospheres. Positive acting, non-sparking emergency governor protects the DP turbine against overspeed.



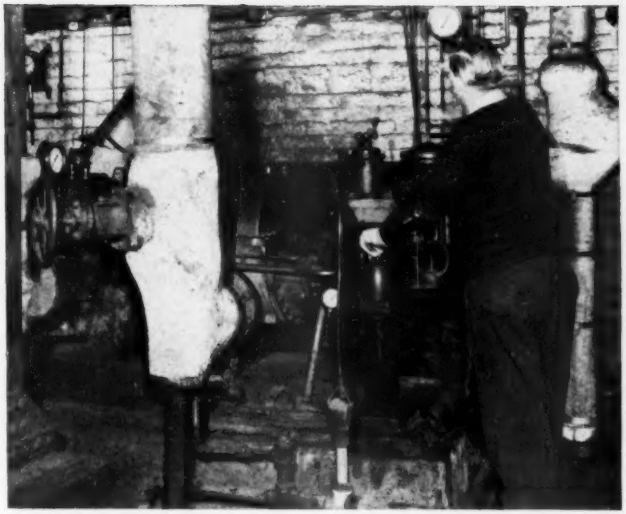
PRECISION GOVERNING—accurate enough for generator drives—is yours with the DP's hydraulic system. Regulation is 6 per cent with a 30 per cent range of speed adjustment. For process governing, regulator control is available.

Ask your General Electric representative for full details about the DP mechanical-drive turbine, or write for bulletin GEA-4955, General Electric Company, Schenectady 5, New York.

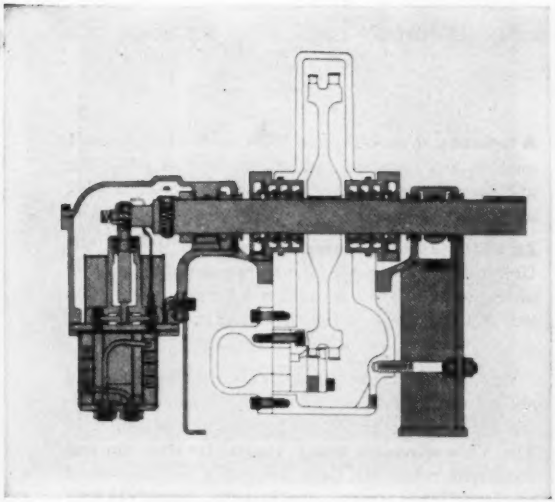
GENERAL ELECTRIC

252-50

MECHANICAL-DRIVE TURBINES



DEPENDABILITY is built into the DP. Positive lubrication through automotive-type bearings adds years to the life of the turbine. Special steel nozzle plate, self-lubricating graphite packings, and Monel-sprayed shaft are examples of design features that spell reliability.



APPLICATION FLEXIBILITY As the shaded parts in the diagram illustrate, most DP parts are identical on all frame sizes and ratings. In this way, you can adapt a DP for different job requirements with only minor changes. A different nozzle plate gives you a new horsepower output. A change in governor gears provides a new speed range. DP's are rated from 10 to 1200 HP and 1000 to 5000 rpm, and with slight modification, can deliver up to 2000 HP and 10,000 rpm. During a change in plant operation, the DP's flexibility will save you money.

EASY MAINTENANCE Because most parts are interchangeable on all models, spares can be stocked at low cost. A spare parts kit, containing 91 items, can be obtained with the turbine. This simple method of stocking spares lowers maintenance costs and provides protection for several DP's in your plant. All models, regardless of frame size, horsepower, or speed ratings, have identical shaft height, keyways, and coupling fits. Thus, installation problems are simplified; you can move these center-line supported units from job to job without a custom line-up.

ONE VU LEADS TO ANOTHER

When VU Boilers were first put on the market, *all* of them, quite naturally, had to be *sold*. Now a very substantial percentage are *bought*. Bought by companies that know by their own first-hand experience what they can expect in day-in and day-out performance—for example:

A paper company some years ago, in urgent need of more capacity, purchased a VU Unit. It went on the line, and—under wartime demand—*stayed there* for 432 days without a shutdown. What do you think they bought when next in the market in 1946? That's right . . . another VU (much bigger than the first).

An automobile company installed its first VU Units (2) in 1947. Two more were ordered for another of its plants in 1948; then three more units for a third plant in 1949 and two more for still another plant in 1950.

A refinery ordered its first VU Unit in 1937. In 1941 another was installed and still another in 1950. For another of its plants two units were ordered in 1942 and a third in 1947.

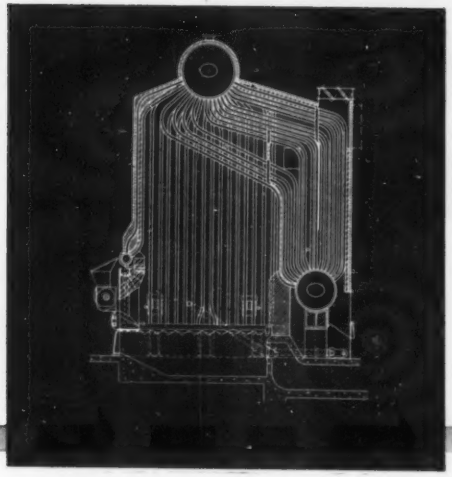
An electric utility company installed its first VU Unit in 1941. Two more units were ordered for another of its plants in 1947, a unit for a third plant in 1946 and still another for a fourth station in 1949.

* * *

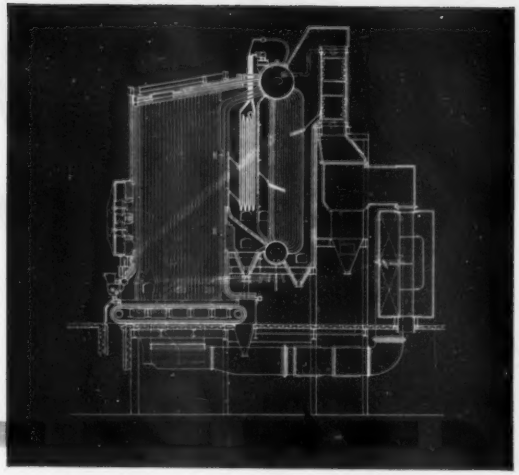
And so it goes — in all sections of the country — and abroad — industry after industry ordering and *reordering* VU Boilers. There must be a reason—and there is. The VU's advanced design, rugged construction and consistent reliability have become a service-proved answer to lower steam costs. You can choose VU with confidence based on the experience of companies in *your* industry, in *your* area. B-485

COMBUSTION ENGINEERING

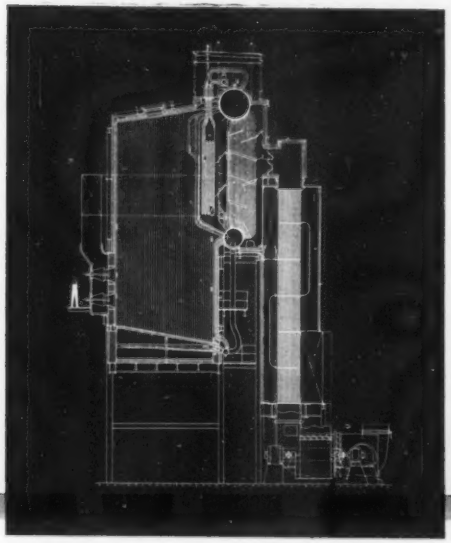
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



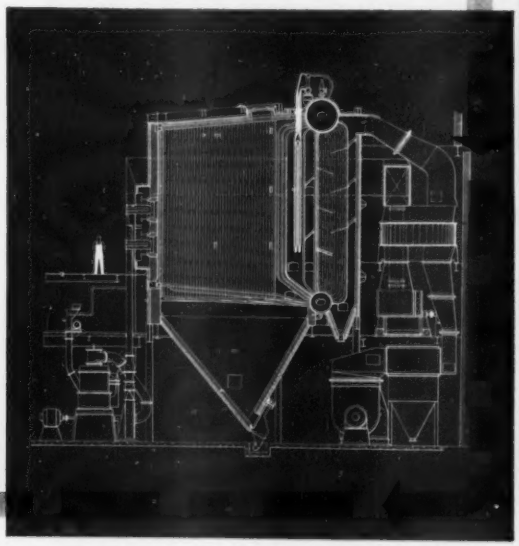
VU-10 Unit fired with C-E Spreader Stoker (dumping grate type). VU-10 Boilers range in capacity from 10,000 to 60,000 lb of steam per hr. May also be fired by underfeed or traveling grate stokers, or by oil or gas.



VU-50 Unit fired with C-E Spreader Stoker (continuous discharge type); auxiliary gas and oil burners in upper front wall. Capacity of unit shown is 90,000 lb steam per hr; operating pressure—650 psi; steam temperature—825F.



VU-50 Unit fired with natural gas or oil. Design provides for future pulverized coal firing. Capacity of unit shown is 350,000 lb of steam per hr; operating press.—920 psi; steam temp.—905F.



VU-50 Unit fired with pulverized coal using C-E Raymond Bowl Mills. The capacity of unit shown is 150,000 lb of steam per hr; operating pressure—600 psi; steam temperature—700F.

— SUPERHEATER, INC.

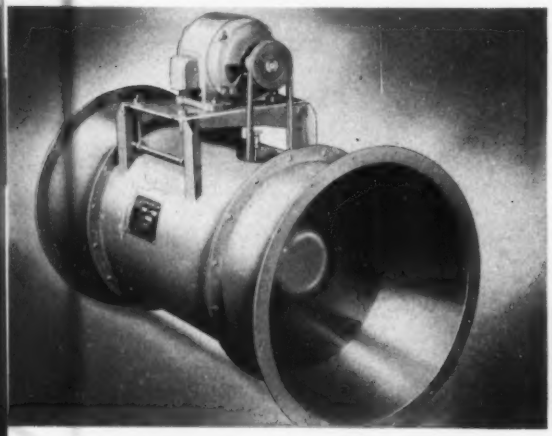
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

POWER GENERATING *Cutting Costs*

THESE "Buffalo"

● Like these two "Buffalo" Induced Draft Fans in an oil company installation, "Buffalo" Draft Fans everywhere are helping to produce inexpensive power for industry and the home. Endurance is the big factor in draft fans that produces economy . . . the economy of long service with minimum time-outs and repairs. All "Buffalo" Draft Fans — Induced, Forced, Primary Air, Cinder Eliminating — have this heavy construction — heavy plate for housings and blades — heavy, oversize rotors, shafts and bearings — to stand up under the heat, erosion and constant punishment of draft service . . . "Buffalo" Induced Draft Fans have large water-cooled bearings, welded-on wearing strips on the rotor blades and removable scroll liners. For complete data, write for BULLETIN 3750.



THESE "Buffalo" VANEAXIAL FANS - - INSTALLED LIKE A SECTION OF DUCT

Relatively light weight and straight design in "Buffalo" Type "B" Axial Flow Fans give big installation advantages. These fans can be duct-mounted overhead or in vertical roof exhausts as the photo above shows, saving space and reducing installation expense. "Buffalo" Vaneaxials are widely used for "boosting" an existing ventilating system, for exhausting and for supplying air conditioning units.

In the straight-line installations referred to here, "Buffalo" Vaneaxials are especially efficient. They do not, however, replace the centrifugal fan, whose efficiency is retained even when installation is near a curve in the duct. BULLETIN 3533-C gives a performance comparison chart of the two fans. A copy will be mailed to you on request.

"Buffalo"

VENTILATING • FORCED DRAFT • COOLING • HEATING
AIR TEMPERING • AIR WASHING • INDUCED DRAFT
PRESSURE BLOWING • EXHAUSTING

SUPPLYING AIR FOR A LARGE SYSTEM

THIS "Buffalo" "LL" FAN

Here is one of the most recommended fans for general ventilation and supplying air washers and air conditioning cabinets. You'll see "Buffalo" Limit-Load Fans in every industry, delivering as high as half a million cubic feet of air a minute in some installations. Special scroll shape, double backward curved blades, directional inlet vanes and rotors dynamically balanced at the factory — are a few of the superior features in "LL" Fans. For further information . . . write for BULLETIN 3737.

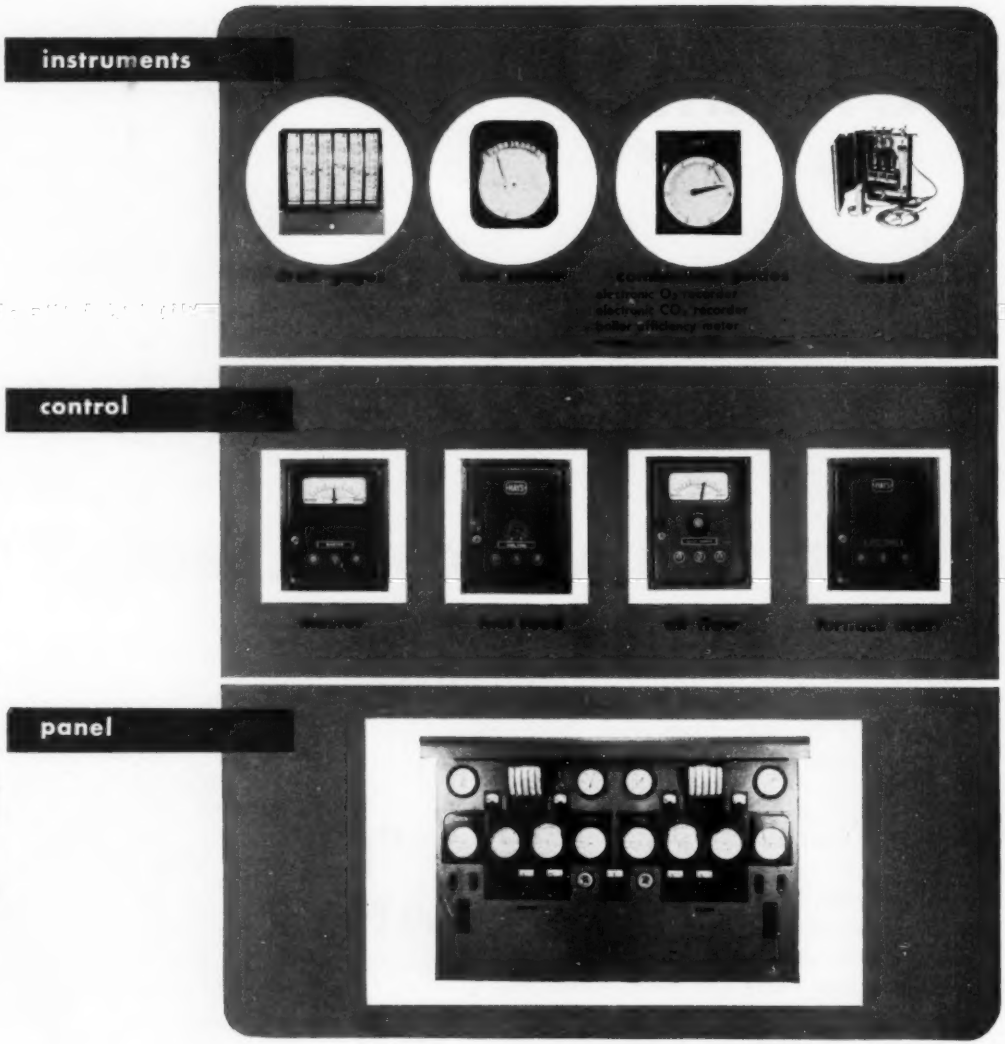
BUFFALO FORGE COMPANY

488 Broadway Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch offices in all Principal Cities

This HAYS boiler plant line



can give you *results* like these

Increased efficiency "Our basic reason for installing the Hays electric automatic combustion control was to obtain better efficiency. Our aim was more than reached . . . efficiency has climbed, attaining 79.3%."

Plant Engineer
Manhattan Rubber Div.,
Raybestos-Manhattan, Inc.

Rapid response to wide load swings "We have made test runs using the Hays system, bringing the load rapidly up from 8,000 to 80,000 lbs. per hr. with excellent results. Fuel-air ratio was held at the desired value and CO_2 at 15%."

Chief Engineer of Power Plant
Bemis Bros. Bag Company

Good CO_2 "The (Hays) controls in combination with our instruments make it possible to maintain high efficiency, as indicated by the 14½% average. CO_2 obtained, and keep complete records of our operation."

Chief Engineer
Geo. Ziegler Company

Low maintenance "Our aim has always been to eliminate the need for maintenance wherever possible . . . and we are particularly pleased that maintenance has been 'nil' with the (Hays) automatic combustion control system."

Chief Engineer
Kurth Malting Company

Fuel savings "Our fuel cost per pound of steam has dropped so much since we installed (Hays) instruments and combustion control, that fuel savings alone have been enough to pay for the investment in one year's operation."

Power Plant Chief Engineer
Vollrath Company

Efficiency and savings "The Hays combustion control system has played a large part in enabling us to reduce our fuel bill by 20% as well as to achieve an 81% boiler efficiency rating (by metering tests)."

General Power Engineer
Pullman Standard Car Mfg. Co.

tailored to your specifications

Your conditions are different . . . and Hays engineers tailor the instruments, control and panel to *your* requirements.

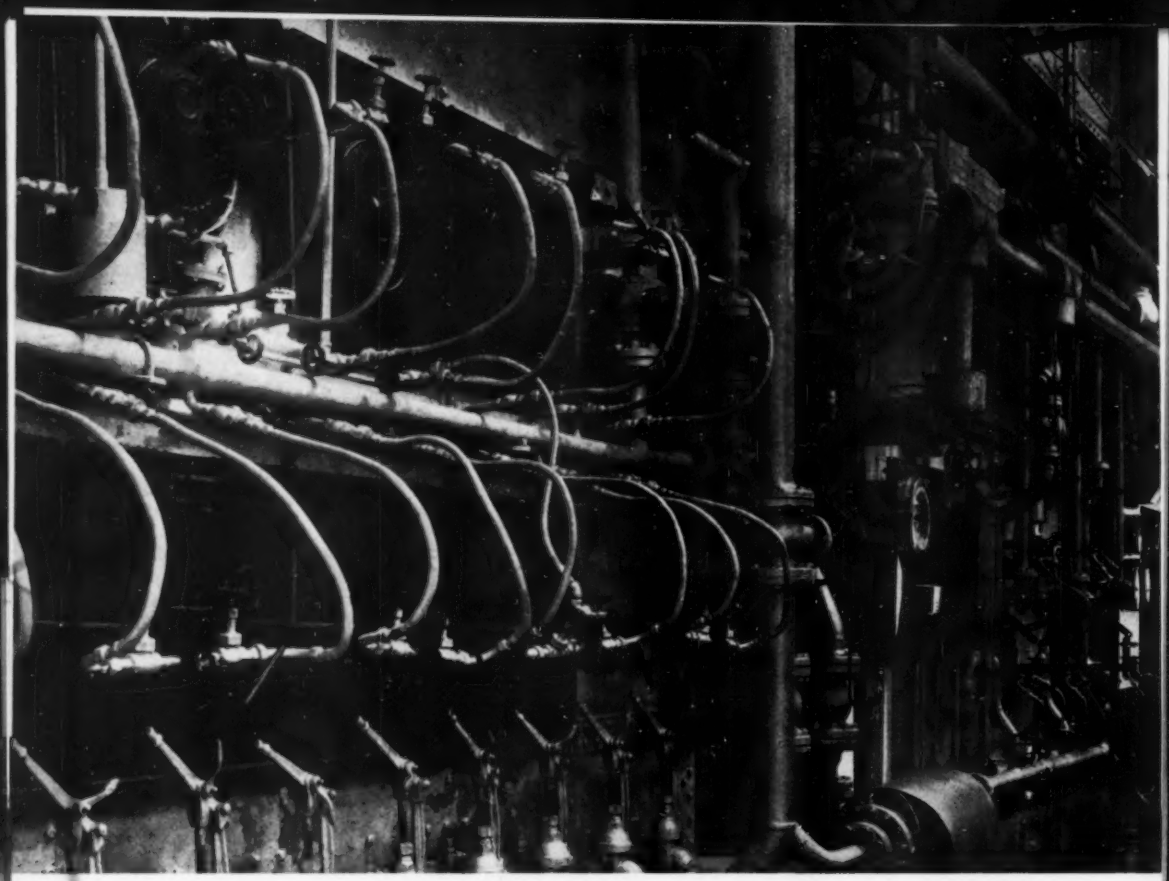
The result? A control system "customized" for your boiler rating, fuel(s), load swings, steam demand, etc. . . . designed to solve the specific problems which plague you . . . with all instruments and controls mounted on a handsome panel laid out, built, and painted according to your instructions.

how to get results

Hays application engineers will provide consultation on the special problems facing your plant. Through careful analysis, working with your actual operating conditions, they will recommend methods to achieve the results you want. Send us a brief statement of your combustion problem for specific preliminary recommendations, without obligation. Ask for Bulletin No. 49-605 and actual case histories of a wide variety of applications.

THE HAYS CORPORATION
MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders



BUSINESS END OF AN OIL FIRED INDUSTRIAL STEAM POWER PLANT. TONS OF GLADDING, McBEAN & CO. FIREBRICK LINE THE FIREBOXES OF THESE THREE UNITS. TOGETHER THEY GENERATE HUNDREDS OF THOUSANDS OF POUNDS OF STEAM PER HOUR FOR HEAT, LIGHT AND POWER IN THIS WESTERN PLANT.

WESTERN POWER

Refractories Are Its Building Blocks!

In the West, steam power is vital to many manufacturing processes. Steam often is the motive force for giant industrial presses—sometimes it is used for heat alone, as in food processing or paper making. Refractories are the building blocks of steam power because they harness the heat and flame of the boiler's firebox.

Gladding, McBean & Co., the largest manufacturer of refractories in the West, plays an important part in the generation of western steam power. The company provides localized refractories service in all six of the major industrial areas of the coast. These warehouses and manufacturing plants supply refractories for every known make of boiler. Gladding, McBean & Co. Refractories Sales Engineers work out of each office, consulting with power engineers, helping to specify the proper refractories and advising on their installation. Gladding, McBean & Co. Research Engineers work closely with boiler manufacturers to develop new and better refractories for longer and more profitable service.

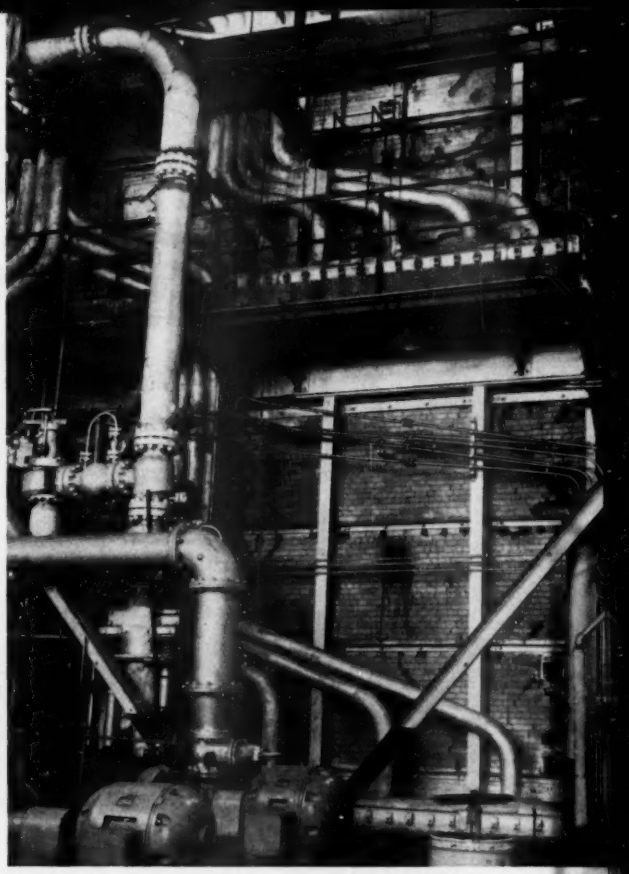
The quality of Gladding, McBean & Co. refractories is backed by over 75 years of ceramic manufacturing experience. The company gets its raw materials from large, highest-quality clay deposits in California, Washington and Oregon. Its manufacturing plants are among the best equipped in the country. No wonder Gladding, McBean & Co. is the primary source of refractories for western power plant operators.

GLADDING, McBEAN & CO.

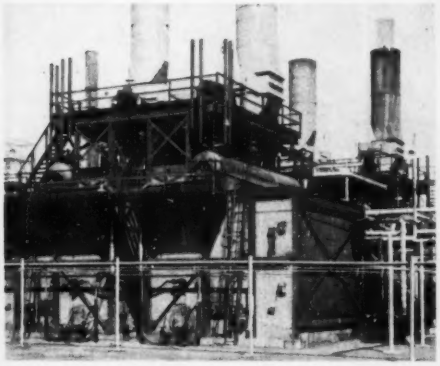
Los Angeles • San Francisco • Seattle • Tacoma • Portland • Spokane

REFRACTORIES MADE IN THE WEST FOR WESTERN INDUSTRIES

Western Power...

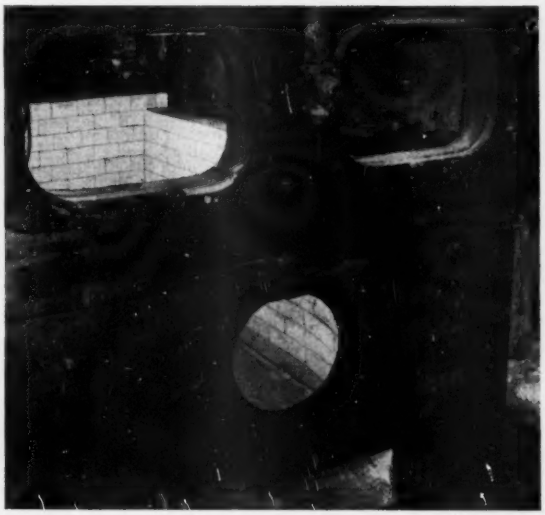


THREE STORY HIGH power nerve center of this Western manufacturing plant relies on Gladding, McBean & Co. refractories in the walls and roof of the boiler setting.



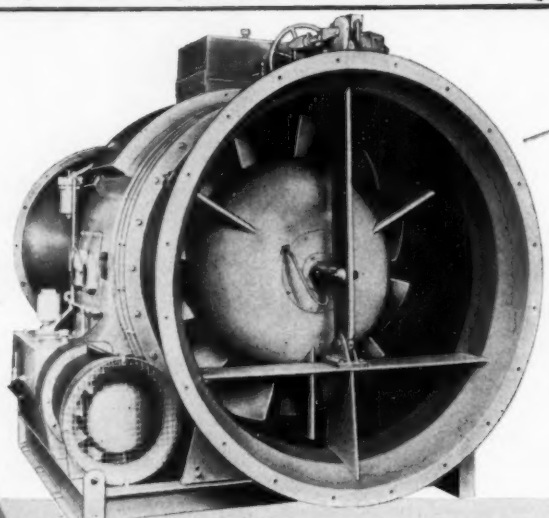
STEAM FOR GASOLINE stills and catalytic crackers comes from this refinery heater—a boiler that plays a vital part in producing many products from petroleum.

WEIGHING IN the raw materials for a new batch of firebrick. Strict laboratory control of all manufacturing operations gives GMcB refractories their high quality.

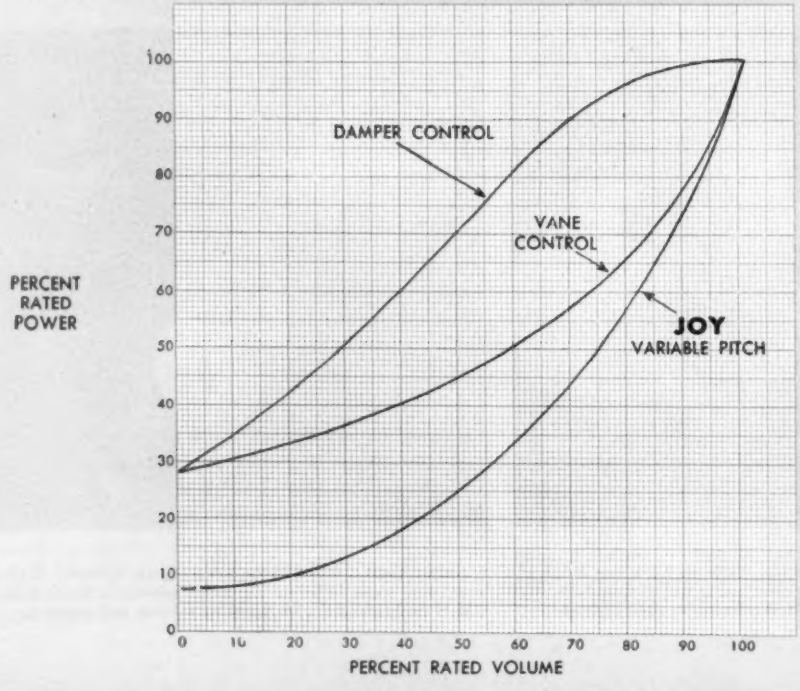


COMFORTABLE GUESTS in warm rooms upstairs, don't know about this small boiler in the hotel basement. Its new lining of GMcB firebrick will give years of service and comfort.

Look How You Can SAVE POWER at REDUCED VOLUMES ..

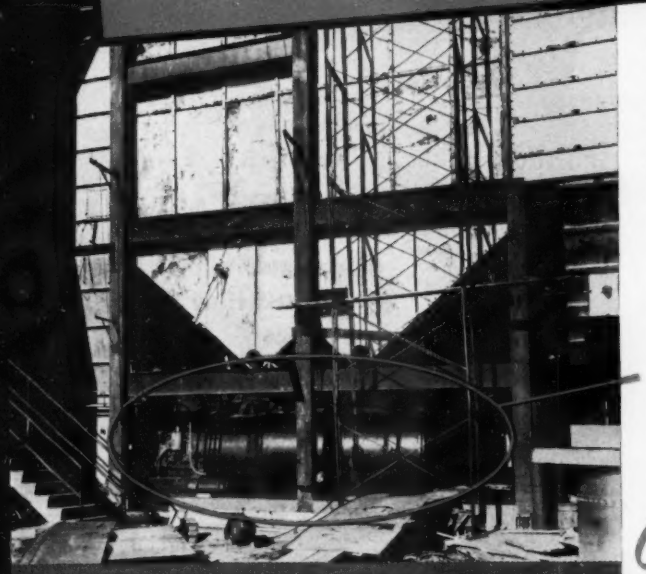


COMPARISON CURVES OF VOLUME CONTROL METHODS



...with JOY AXIVANE® FORCED DRAFT FANS

...employing VARIABLE-PITCH BLADES manually or automatically controlled



ADVANTAGES and EXCLUSIVE FEATURES

JOY Forced Draft Fans with Variable-Pitch Blades are ideally adapted for any desired type of automatic control, or can be readily manually controlled. The response is quick and accurate.

Operating at constant speed, direct-connected, these JOY Fans are of the well-known vaneaxial type. This highly efficient design affords the most favorable air volume-to-power consumption ratio, as well as low noise levels. The design is compact and simple, requiring minimum headroom and promoting easy installation, ready servicing, and trouble-free operation with least maintenance. ● On fans for pressurized-type boilers or "cyclone" furnaces, check first with JOY—world's largest manufacturer of vaneaxial-type fans.

HERE'S A TYPICAL JOY INSTALLATION

Notice how compactly the fan with its sound-absorbing set tucks away under the boiler in minimum space. This 400 HP JOY Variable-Pitch Fan is serving a pressurized-type boiler in a new southwest power station. It is 66" in dia., operates at 1750 RPM, and supplies 80,000 CFM at 25" WG.

1851-1951 . . . 100 YEARS OF ENGINEERING LEADERSHIP

Consult a Joy Engineer

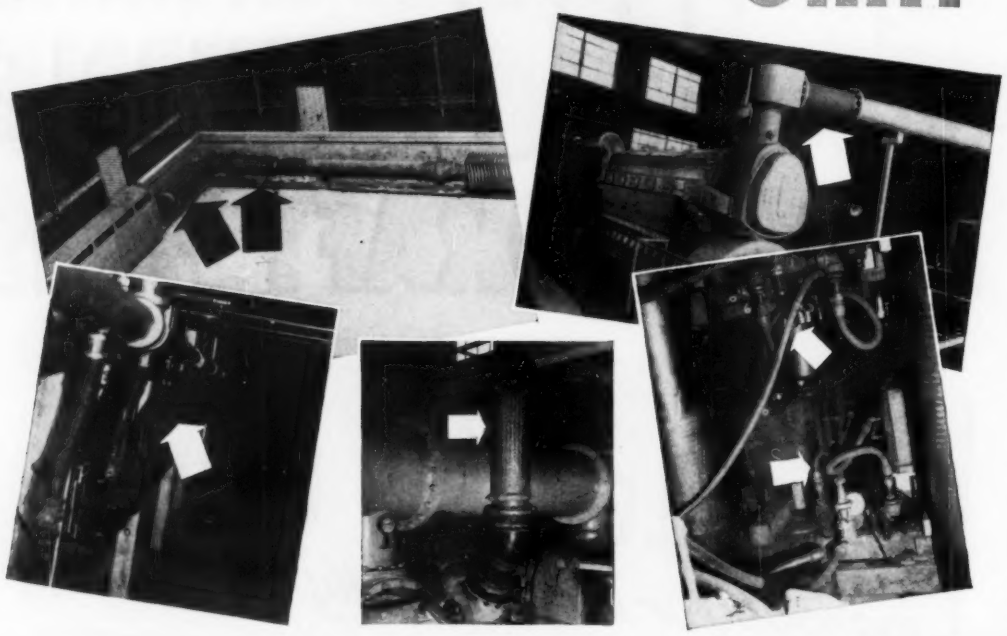
W&D 13654

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

The time and trouble-saving uses of CMH



- ✓ Oil Burner connections
- ✓ Gas connectors
- ✓ Steam lines
- ✓ Lubrication hose
- ✓ Pneumatic hose
- ✓ Chemical hose
- ✓ Tar and Asphalt lines
- ✓ Diesel Engine Exhaust connections
- ✓ Vacuum lines
- ✓ Refrigerant lines
- ✓ Armor
- ✓ Ventilating ducting
- ✓ Exhaust ducting

Whenever vibration, misalignment, flexation or expansion and contraction exist in any of these services (and many others) use CMH FLEXIBLE METAL HOSE

CMH —One dependable source for

FLEXIBLE METAL HOSE

are virtually unlimited in any type of plant

Motion or misalignment in piping is a serious and potentially dangerous problem that exists in almost every plant . . . but, in most cases the solution is a simple one—use CMH Flexible Metal Hose as the connecting link between moving parts or between misaligned sections. Whether the motion is a fraction of an inch or scores of inches, there is a suitable type of CMH Flexible Metal Hose to meet the need.

For conducting liquids or gases or even granular solids . . . hot or cold . . . CMH Flexible Metal Hose combines the rugged durability of metal with a high degree of flexibility. In addition, CMH Flexible Metal Hose gives you the non-aging, non-contaminating characteristics so necessary to long, trouble-free service.

In CMH's complete line of flexible metal hose products there are types suitable for pressures up to 12,000 psi (burst) and for temperatures from far below zero to 1600° F. Whatever your connection problem or if you require durable, heat and corrosion resistant hand hose, get full information on CMH Flexible Metal Hose from your CMH distributor. See your classified telephone directory or write for his name. If you would like to have descriptive literature, write for it, mentioning the nature of your requirements.

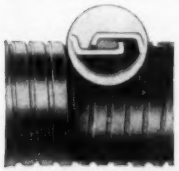
CHICAGO METAL HOSE CORPORATION

1301 S. Third Ave. Maywood, Illinois

Plants at Maywood, Elgin, Rock Falls and Savanna, Illinois

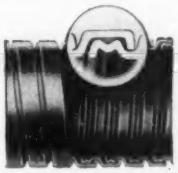
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ontario

CMH corrugated hose is available in steel, bronze and stainless steel for high temperature, high pressure applications.



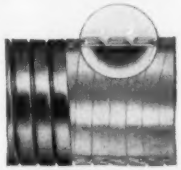
CMH square locked hose is available in steel or bronze with a variety of packings for use as nozzles, armor, ducting, etc.

CMH interlocked hose is available in steel, brass and other alloys for use as ducting, armor, exhaust lines and similar applications.



CMH ball bearing design hose is available in steel, bronze or stainless steel with a variety of packings and with or without metal braid covering for low pressure service.

CMH interlocked steam, oil and tar and asphalt hose is available in steel or bronze with asbestos packing for medium pressure utility service.



CMH abrasion resistant interlocked tubing is available in steel for conveying dry solids such as grain, sawdust, ashes, etc.

In addition to the types illustrated CMH also manufactures standard hose assemblies for such services as steam, tar and asphalt, machine tool conduit, also metallic bellows and expansion joints for piping.

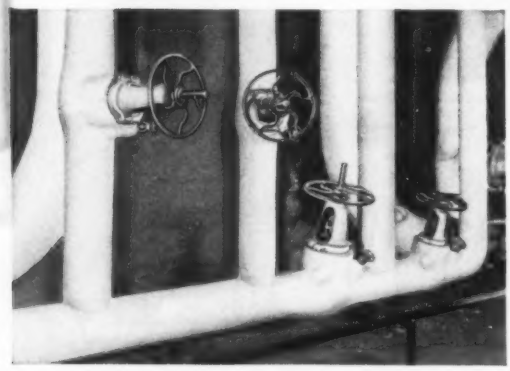
every flexible metal hose requirement

a better gate valve for 600-pound services ...CRANE pressure-seal bonnet design

Better—because these Crane valves completely eliminate bonnet joint maintenance. And because they assure power plants—industrial and utility—ideal flow conditions, with many added cost-reducing advantages.

For instance, they save on erection and suspension costs, because, size for size, Crane Pressure-Seal Bonnet Gates are much lighter in weight and more compact than flanged bonnet steel valves. Insulating Pressure-Seal valves takes less time and materials because of streamline contouring.

For complete information about Crane 600-Pound Pressure-Seal Bonnet Gates—also companion lines of 900 and 1500-Pound Gates, Globes, Angles, and Stop-Checks—send for Circular Ad-1819, or ask your Crane Representative for a copy.



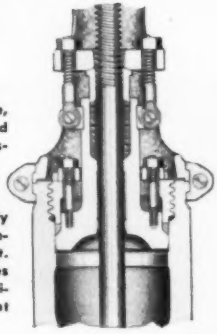
Boiler feedwater header in central station. No danger of bonnet-joint leakage; valves are Crane Pressure-Seal Bonnet Gates.

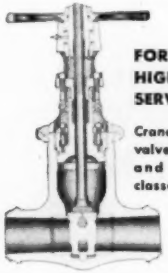
Patented and Patents Pending

600-Pound Butt Welding Gate for temperatures up to 1000° F. max.

NO BONNET-JOINT LEAKAGE OR MAINTENANCE

Bonnet joint is inside the valve, sealed with a wedge-shaped seal ring. Internal fluid pressure, acting upon the entire underside of bonnet, forces bonnet against seal ring and wedges it between the body and bonnet to form a pressure-tight metal-to-metal joint. Since pressure tightness does not depend on bolting, no periodic restressing of bonnet joint is needed.





FOR HIGH-PRESSURE HIGH-TEMPERATURE SERVICES

Crane Pressure-Seal Bonnet Gate valves are also available in 900 and 1500-Pound pressure classes.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

MODERN STEAM GENERATING UNITS

. . . any size . . . any pressure . . . any temperature . . . and for any fuel

SPRINGFIELD BOILER CO. specializes in the production of modern steam generating equipment . . . ANY SIZE . . . ANY PRESSURE . . . ANY TEMPERATURE . . . AND FOR ANY FUEL. Springfield is organized to apply the same *engineering skill* to all contracts, large or small. This is one of the reasons why Springfield is the choice of an increasing number of power engineers interested in having careful attention given to their jobs. Springfield service includes design, fabrication, erection and placing in operation of the complete unit. We will be glad to submit a proposal covering your requirements.

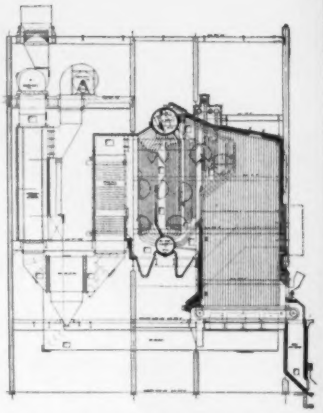
SPRINGFIELD BOILER CO.

1953 E. Capitol Ave. • Springfield, Illinois, U.S.A.

Worldwide Sales and Service

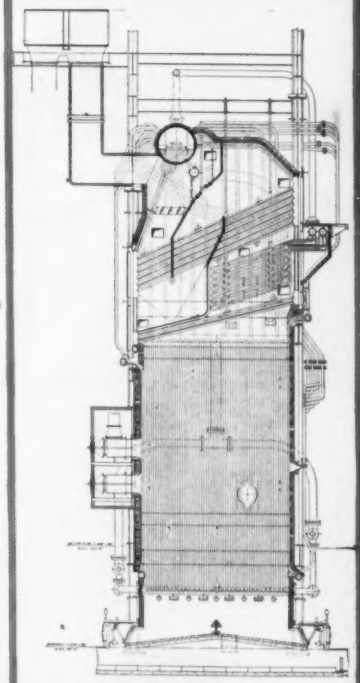
BENT TUBE BOILERS • STRAIGHT TUBE BOILERS • SUPERHEATERS • DESUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATERWALLS • PACKAGE BOILERS • COMPLETE STEAM GENERATING UNITS

Check with your Consulting Engineer on Modernization and New Plant Projects

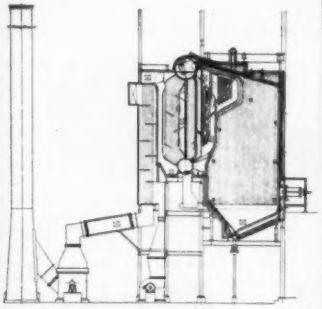


ELK RIVER STEAM PLANT, ELK RIVER, MINN.—120,000 lb. Springfield two drum, bent tube steam generator (2 units) complete with water cooled furnace, air heater, economizer, forced and induced draft equipment, instruments and controls. Operating pressure, 615 p.s.i. 830° F. controlled total steam temperature at superheater outlet.

Ralph D. Thomas and Associates, Inc.
Consulting Engineers, Minneapolis, Minnesota

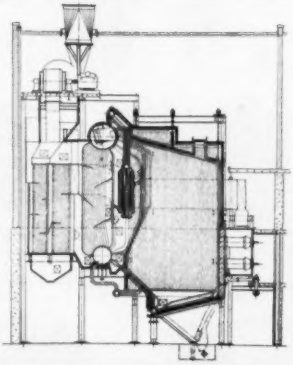


IOWA ELECTRIC LIGHT & POWER CO., CEDAR RAPIDS, IOWA—300,000 lb. Springfield installation (4 units). This design features Springfield's exclusive center water wall (divided furnace) type of construction. 750 p.s.i. design pressure, 750° F. total steam temperature at superheater outlet at 700 p.s.i. operating pressure with pulverized coal firing.



CHARTER OAK STEAM PLANT, BELTON, TEXAS—A modern, two drum 130,000 lb. Springfield steam generator (2 units) complete with water cooled furnace, superheater, air heater, forced and induced draft equipment. 630 p.s.i. pressure. 825°F. total steam temperature at superheater outlet. Firing with gas and oil.

Laramore & Douglass, Inc. Consulting Engineers, Chicago, Illinois

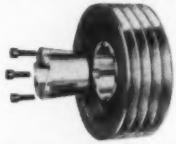


CITY OF COLORADO SPRINGS, COLO.—A 150,000 lb. Springfield bent tube, two drum steam generator complete with water cooled furnace, superheater, air heater, forced and induced draft equipment. 410 p.s.i. pressure. 750°F. total steam temperature at superheater outlet. Gas or oil firing with future provision for pulverized coal.

Lutz & May, Consulting Engineers, Kansas City, Missouri

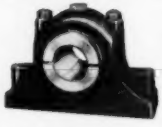
SEE OUR CATALOG IN SWEETS

IF IT'S DODGE -IT'S DEPENDABLE!

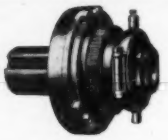


TAPER-LOCK SHEAVES: Patented. Taper-Lock is the world's simplest mechanism for mounting wheels to shafts. Easy on—easy off! 476 stock sizes in A, B, C and D grooves.

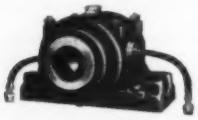
TORQUE-ARM SPEED REDUCERS: America's most complete line of shaft mounted speed reducers. Capacities from 1 to 27 h.p. Output speeds from 12 to 330 r.p.m.



DODGE-TIMKEN BEARINGS: Mounted units, proved in millions of industry's toughest jobs. The famous 30,000-hour line. Four types to choose from. Sizes from 1-3/16" to 8".



ROLLING GRIP FRICTION CLUTCHES: No toggles! Compact, flexible, smooth and DEPENDABLE. Bolted plate and gear tooth plate. 1.3 to 21.2 h.p. at 100 r.p.m.

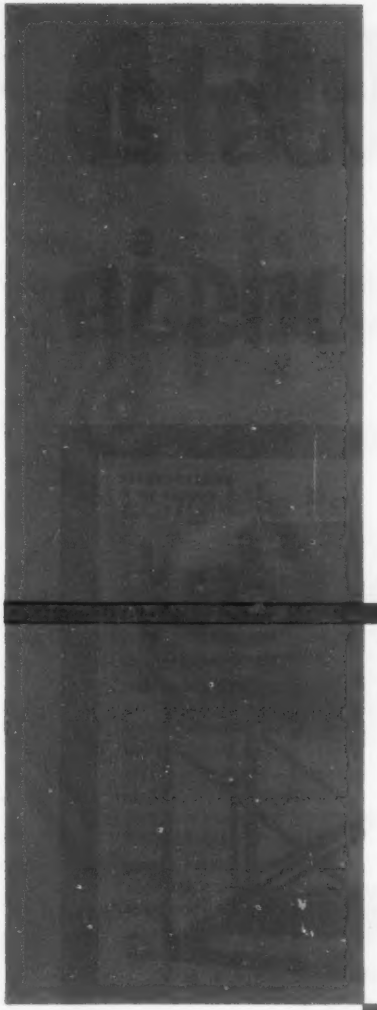


SLEEVOIL BEARINGS: Precision built, exceptionally quiet, thoroughly dependable. "Tops" for fan and blower service. Sizes 1-7/16" to 8" in both plain and water cooled types.

SOLID STEEL CONVEYOR PULLEYS: Maximum strength, minimum weight. *Modern* pulleys with interchangeable hubs that cut installation cost. Diameters 6" to 8'. All face widths.

DODGE SEALED-LIFE V-BELTS: Special protection for tension members insures longer belt life. Perfectly matched to Taper-Lock sheaves for best performance.

DODGE TAKE-UPS: Modern, rugged, dependable. Roller bearing (illustrated), ball bearing and babbitted. Shaft sizes from 3/4" to 4". Travel from 4" to 36".



SPECIALISTS IN POWER TRANSMISSION MACHINERY FOR 73 YEARS

NOTED THROUGHOUT THE WORLD FOR HIGH QUALITY, PRECISION MANUFACTURE

MANUFACTURERS OF A BROAD LINE OF MECHANICAL POWER TRANSMISSION MACHINERY

ORIGINATORS OF NEW AND BETTER PRODUCTS FOR THE MECHANICAL TRANSMISSION OF POWER

USED CONFIDENTLY WHERE THE GOING IS TOUGHEST

DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

CALL THE TRANSMISSIONEER: Most Dodge products are normally available from distributors' stocks—in your territory—when you need them. For information on the newest and best methods of mechanical power transmission, call the Dodge Transmissioneer, graduate of the Dodge factory course. He is your local Dodge Distributor. Look for his name under "Power Transmission Equipment" in your local classified telephone directory.

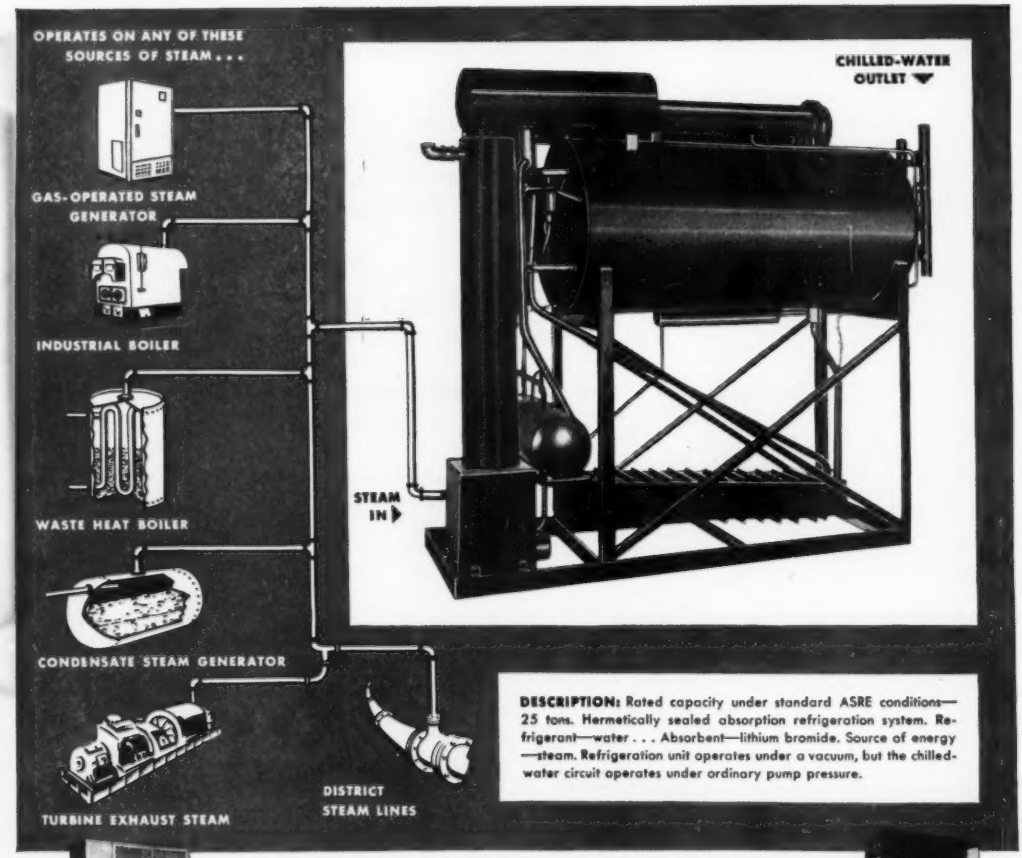
PILLOW BLOCKS: Roller Bearing, Ball Bearing, Babbitted. **FLANGE BEARINGS:** Roller, Ball, Babbitted. **HANGER BEARINGS:** Roller, Ball, Babbitted. **TAKE-UPS:** Roller Bearing, Ball Bearing, Babbitted. **BASE PLATES. FLOOR STANDS. DROP HANGERS. V-BELT SHEAVES:** Both TAPER-LOCK and Bored-to-Shaft-Size. **BELTS:** Industrial and FHP V-Belts and Flex-Link Belting. **SPEED REDUCERS:** TORQUE-ARM Shaft Mounted Speed Reducers. **CLUTCHES, FRICTION:** Rolling Grip, Diamond D and Solid Types. **COUPLINGS:** TAPER-LOCK Flexible, TAPER-LOCK Rigid and Flange Types. **SAFETY SET COLLARS. PULLEYS:** Steel Split Transmission and Solid Steel Conveyor Pulleys. Rubber Lagging. **VISES:** SLIDE-SET Machinist's...FOR COMPLETE LINE, TYPES AND SIZES, WRITE FOR BULLETINS AND 224-PAGE CATALOG.

DODGE

of Mishawaka, Ind.

"First in Power Transmission Machinery!"

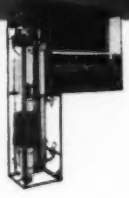
New Servel Water new horizons in


OPERATES ON ANY OF THESE SOURCES OF STEAM . . .
GAS-OPERATED STEAM GENERATOR
INDUSTRIAL BOILER
WASTE HEAT BOILER
CONDENSATE STEAM GENERATOR
TURBINE EXHAUST STEAM
DISTRICT STEAM LINES
CHILLED-WATER OUTLET
STEAM IN
DESCRIPTION: Rated capacity under standard ASRE conditions—25 tons. Hermetically sealed absorption refrigeration system. Refrigerant—water . . . Absorbent—lithium bromide. Source of energy—steam. Refrigeration unit operates under a vacuum, but the chilled-water circuit operates under ordinary pump pressure.

SERVEL STEAM-OPERATED AIR CONDITIONERS

Self-Contained Unit. 5 tons of refrigeration. Heating optional.

Absorption Refrigeration Unit. In 3- and 5-ton sizes. For single or multiple installations.



Chiller opens application flexibility

25-Ton Servel Absorption Unit Provides Long-Life Refrigeration from Inexpensive Steam

The application flexibility of this new Servel Water Chiller makes it an economical source of chilled water for most applications. These points show how easily it will fit your requirements:

NUMEROUS USES—Comfort air conditioning . . . industrial temperature and humidity control . . . precooling for air compressors and internal combustion engines . . . chilled water for manufacturing processes . . . and many others.

STEAM OPERATION—Use the cheapest source of steam . . . any pressure will do. Use the cheapest fuel to make steam—waste heat or manufacturing by-products if available . . . or waste steam.

SIMPLE INSTALLATION on any floor from basement to penthouse . . . in multiple or single installations . . . low floor loading . . . no vibration . . . quiet operation.

MODULATION—Use simple steam controls to reduce capacity of the Servel unit as much as 50% . . . with no appreciable loss of efficiency.

In addition to these important flexibility factors, the new Servel Water Chiller also offers the famous Servel no-moving-parts freezing system. This insures dependable operation, long life, and low maintenance. Add this advantage to its numerous uses, its steam operation, simple installation and capacity modulation, and you'll choose the new Servel Water Chiller* every time.

Mail coupon now, for complete information.

*NOTE: The nation's present need for critical materials limits the availability of the Servel Water Chiller to defense orders at present. However, the Servel equipment shown at the bottom of the opposite page is available without priorities.

HERE ARE SOME REASONS WHY SERVEL IS YOUR BEST AIR CONDITIONING BUY

- **No Moving Parts to Wear**
- **Low Maintenance Costs**
- **Hermetically Sealed Circuits**
- **Long Life**
- **Complete Safety of Operation**
- **Chilled Water Circuit Operates Under Normal Pump Pressure**

SEND COUPON FOR MORE INFORMATION

Servel

EVANSVILLE 20, INDIANA

WATER HEATERS **AIR CONDITIONING**
HOUSEHOLD REFRIGERATORS

Servel, Inc.
Department X-26, Evansville 20, Indiana

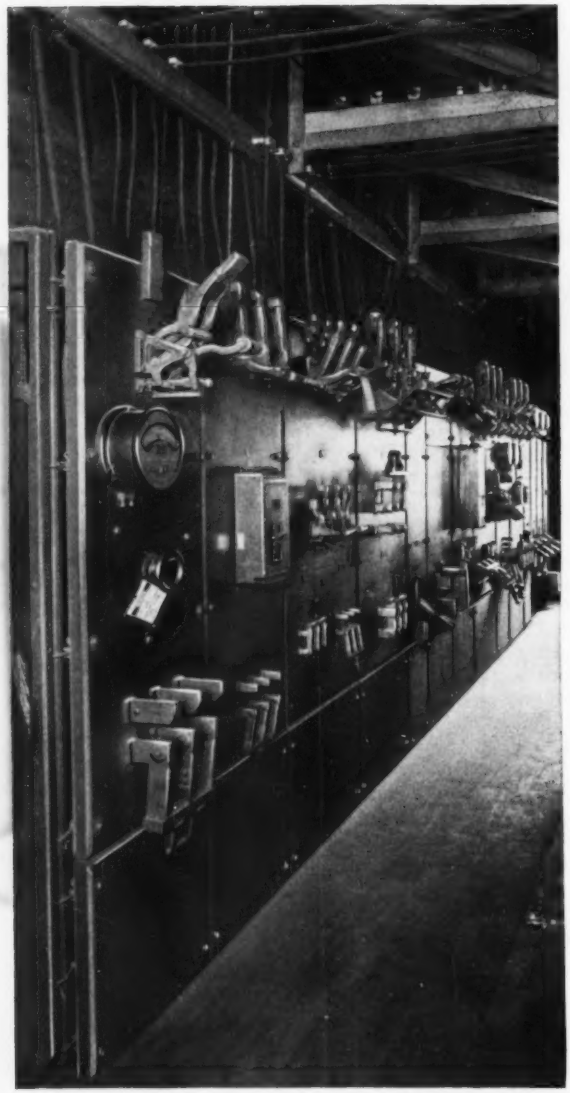
Gentlemen:
Please send me more information on the following:
Servel 25-Ton Water Chiller_____
Servel Self-Contained Air Conditioner_____
Servel 3- and 5-Ton Refrigeration Units_____

*Name*_____

*Firm*_____

*Address*_____

Power bottleneck broken



This is the old open-type switchgear originally installed at the Traylor Engineering & Manufacturing Co. Exposed switches were a safety hazard. With extra feeders added through the years to take care of expansion, the rear of the switchboard had become a tangle of cables, inviting short circuits. Old 240-volt distribution system seriously limited future expansion.

New G-E Metal-Clad switchgear provides for increased output, gives greater safety

Old equipment was inadequate for growing needs

After years of service at the Traylor Engineering & Manufacturing Co., Allentown, Pa., the old-fashioned switchgear shown at left was operating on borrowed time. Already over-loaded through increasing power demands, it had become a bottleneck that limited expansion and hampered efficient production.

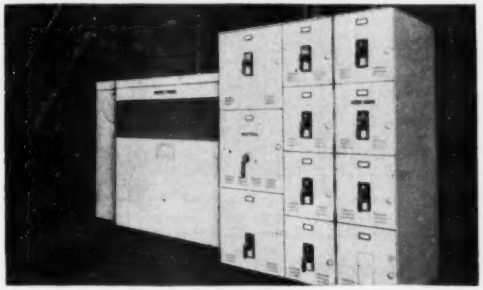
With interrupting devices entirely inadequate to handle the power that could be delivered under short-circuit conditions, any major fault in the system could have been disastrous.

Today this obsolete equipment has been replaced by modern G-E metal-clad switchgear. Dangerous exposed switches have vanished. Interrupting capacity is adequate to take care of abnormal conditions. And a modern high-voltage distribution system assures ample power for years to come. See opposite page.

For information on similar equipment for your plant, contact your G-E sales representative—or write for Bulletins GEA-3083 Metal-clad Switchgear; GEA-3592 Load-center Unit Substations; GEA-3758 Load-center Power Distribution. *General Electric Company, Schenectady 5, N. Y.*

at this Eastern Plant

Modern G-E Metal-clad Switchgear now installed at the Traylor Company provides greater safety because all parts are completely enclosed. For greater protection against short circuits, separate circuits are isolated in individual compartments. Circuit breakers may be easily removed for inspection, with protection for personnel. Power is distributed from this unit at 2400 volts, replacing the old 240-volt distribution system.



Load-center Unit Substation eliminates long low-voltage feeders—saves copper. 2400-volt power is received at this load-center unit substation and stepped down to utilization voltage on the factory floor. Because the substation is located close to the machines it serves, low-voltage feeders are short, saving copper and giving better voltage control. Discarded cable previously used for low-voltage distribution is shown at left.

GENERAL ELECTRIC

854-35

The Canton Binfeed - Another TO SOLVE YOUR STOKER

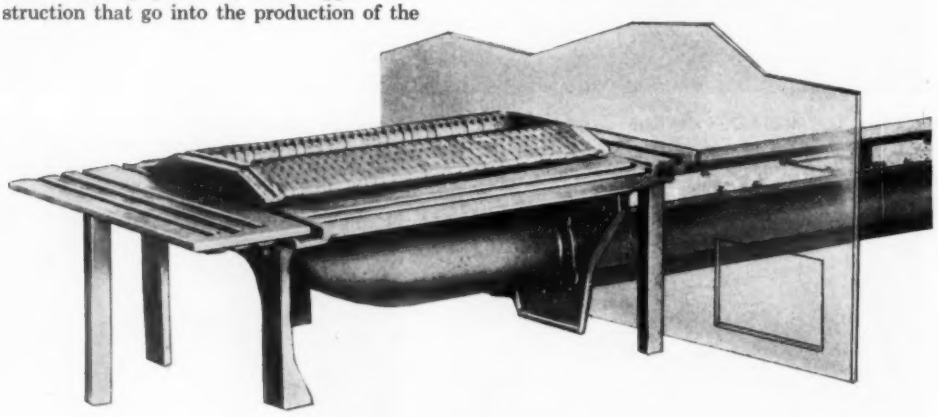
When buying stokers, make sure the equipment you buy fits your operating requirements *exactly*. The dependability of Canton Stokers, established in thousands of installations during the past 40 years, will guarantee you the finest performance in *your* operation because they are designed specifically for YOUR firing and combustion demands.

Keeping pace with the Canton policy of meeting *all* stoker requirements, the CANTON BINFEED STOKER offers several specific operating advantages — less coal handling . . . higher combustion efficiency . . . lower maintenance costs . . . and, most important, CANTON OPERATING RELIABILITY.

The top-quality materials, engineering and manufacturing precision, and rugged construction that go into the production of the Canton Binfeed Stoker would produce an excellent stoker under any standards. But Canton has added exclusive features that provide a superior product which delivers a superior performance.

A binfeed stoker may be your answer to higher firing efficiency. Call or write your nearest Canton Stoker representative. He will be glad to show you, without obligation, how Canton Binfeed Stokers will fit your requirements exactly.

CANTON STOKER CORPORATION
Andrew Place, S. W., Canton, Ohio
CANADIAN REPRESENTATIVE: Volcano Ltd.,
743 Mountain Street, Montreal 3, Quebec
EXPORT DIVISION: W. B. Harkins,
751 Drexel Building, Philadelphia 6, Pa.



CANTON

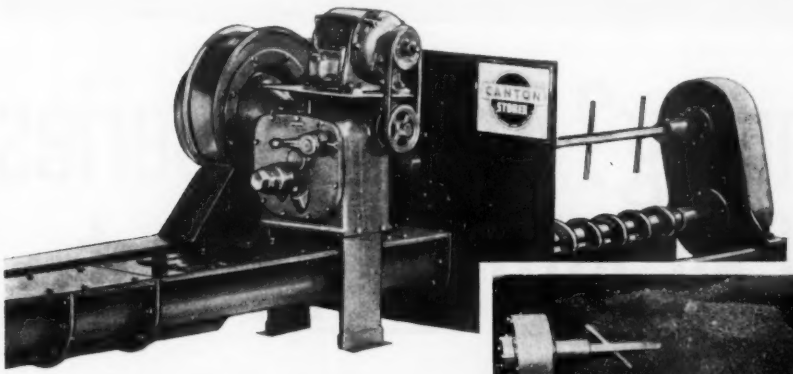
SINCE 1910

Advancement PROBLEMS *EXACTLY!*

CANTON STOKERS

CHECK THESE POINTS

- ✔ **DUAL-DRIVE COAL AGITATOR** — Prevents packing or bridging of coal.
- ✔ **SECTION FEED WORM** — Provides easy removal for maintenance or cleaning.
- ✔ **SIDE ASH-DUMPING GRATES** — Reduces labor in cleaning fires and removing ashes.
- ✔ **ZONED AIR CONTROL** — Produces high-efficiency combustion and maximum fuel economy.
- ✔ **AUTOMATIC CONTROLS** — Provide full-automatic operation.
- ✔ **UNIT OR SEPARATE BLOWER DRIVE** — Gives added flexibility to the installation.
- ✔ **DRIVE UNIT ACCESSIBILITY** — Permits, easy, quick access to all drive parts.
- ✔ **RUGGED CONSTRUCTION** — Assures long uninterrupted service under severe operation.



CANTON DURAFLEX BINFEED STOKER

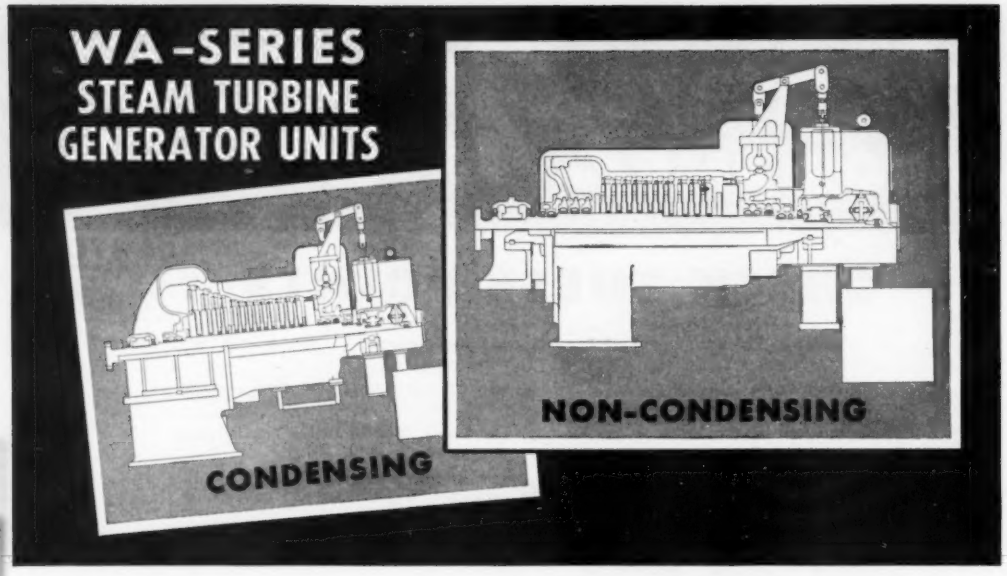
The rugged unit shown here is designed with the drive mechanism and blower units mounted at the outer wall of the coal storage bin.

Action view of the Canton coal agitator and pickup worm, showing completely closed construction of drive gear mechanism.

CANTON RAM FEED STOKER DRIVE MECHANISMS ARE GUARANTEED FOR FIVE YEARS

STOKER

CANTON STOKER CORP. CANTON 1, OHIO



Expanding? The WA-Series will Fit into Your Plant

TODAY INDUSTRY MUST EXPAND while producing at a record rate. To help this vital expansion, Allis-Chalmers offers modern WA-Series steam turbine generator units for industrial and utility steam power plants.

If you prefer high quality construction and modern design, be sure to investigate the recently announced WA-Series, now being built in ratings through 7500 kw. The most recent developments are embodied in this modern impulse design, built for both condensing and non-condensing service, with or without automatic extraction.

Built in NEMA ratings, the WA-Series steam turbine generators are compact, three-bearing, solidly coupled units. They are being built in the condensing type, for power generation only, and in the non-condensing and automatic extraction types, to tie in thermodynamically and provide a steam-power balance where process steam is used.

Design and construction of WA-Series units meet the rigid standards Allis-Chalmers has established for its entire steam turbine line. Just as in the larger steam turbines ranging to 150,000 kw, labyrinth steam seals are used for shaft glands and interstage packing. Corrosion and erosion resistant high chrome alloy steel buckets and nozzles are used throughout in the WA-Series.

WA-Series units are completely coordinated in design. Impulse turbine, housing type air-cooled generator, and exciter are all especially engineered to operate as a unit. *And*, the entire unit is manufactured, assembled, and tested under one supervision at one plant.

Make sure that your next generating unit is *quality* built and has *all* the latest features. Call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3312

ALLIS-CHALMERS

TURBINES & GENERATORS | CONDENSERS & PUMPS | SWITCHGEAR & BREAKERS | MOTORS & CONTROL | TRANSFORMERS | WATER CONDITIONING

World's Widest Range of Power Plant Equipment

PRODUCE MORE WITH YARWAYS...

Is higher production your aim?

Then Yarway is your steam trap. Best steam trap performance requires condensate drainage *plus*—

1. **Air and gas removal.**
2. **Velocity scrubbing of condensate from heat transfer surfaces.**
3. **Keeping highest average temperature in the equipment.**

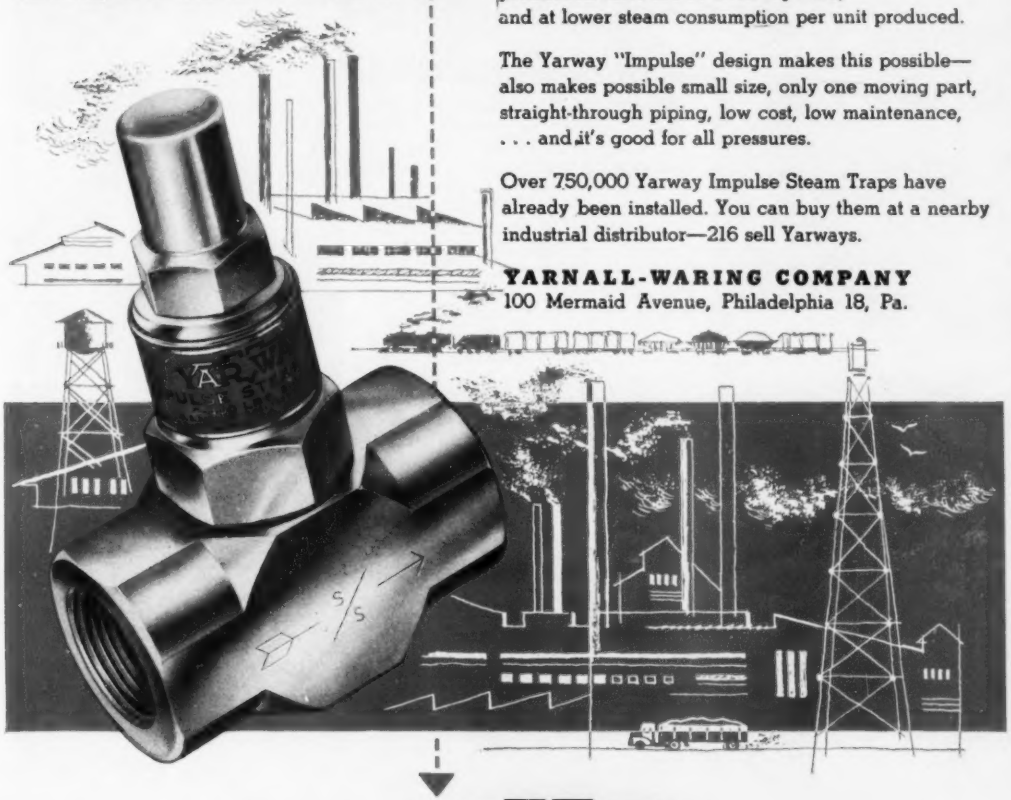
Yarway Impulse Steam Traps do all this, *sending the most premium B.T.U.'s at top temperature into your process or product.*

That's why equipment drained with Yarways gets "hotter, sooner" . . . why better quality and higher production rates are so often reported, and at lower steam consumption per unit produced.

The Yarway "Impulse" design makes this possible—also makes possible small size, only one moving part, straight-through piping, low cost, low maintenance, . . . and it's good for all pressures.

Over 750,000 Yarway Impulse Steam Traps have already been installed. You can buy them at a nearby industrial distributor—216 sell Yarways.

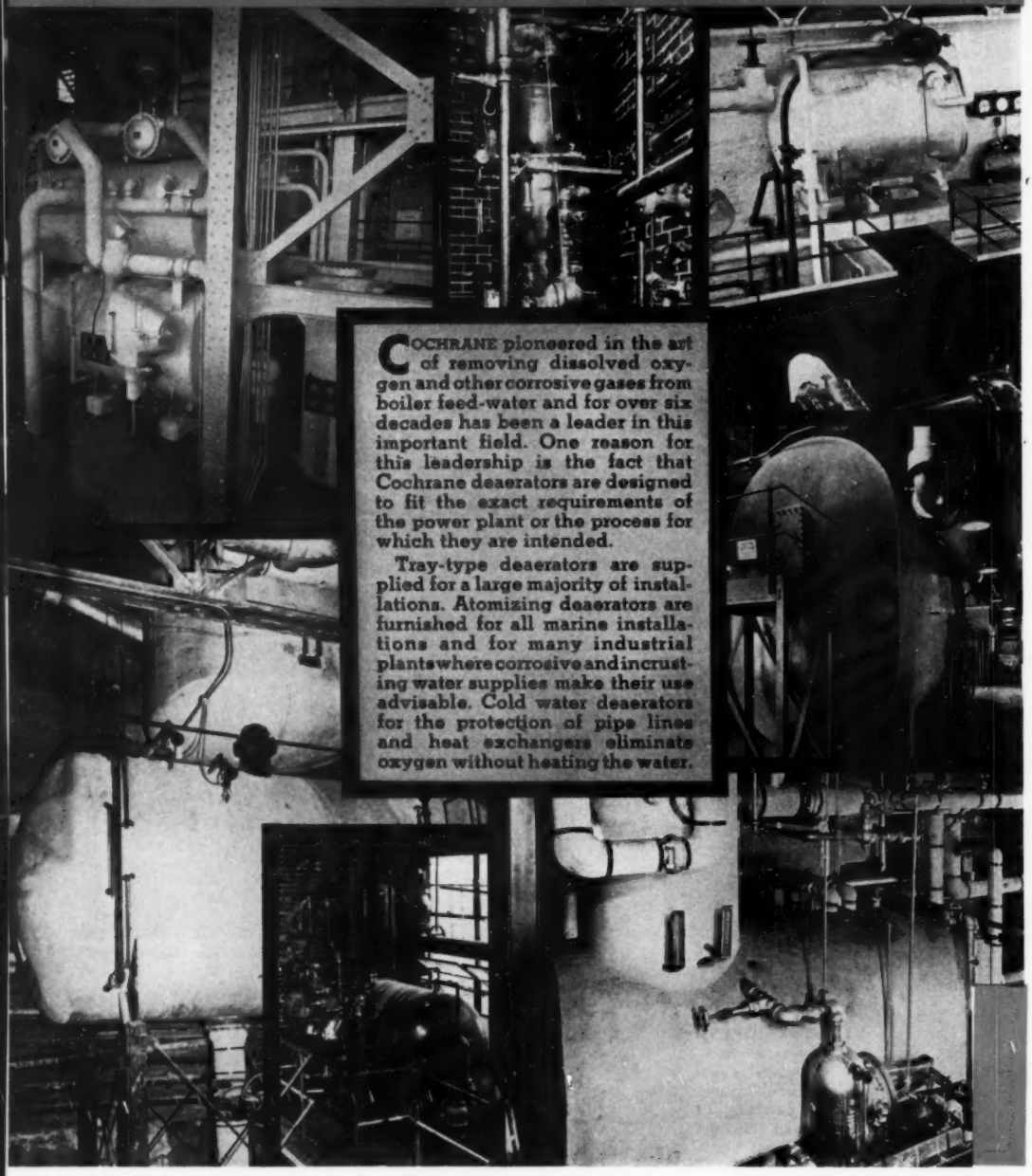
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.



FREE OFFER
Don't take our word for it. Test Yarway's production advantages in your own plant, without cost or obligation. Drop us a card. A trial trap will be delivered promptly.

YARWAY the steam trap designed with production in mind

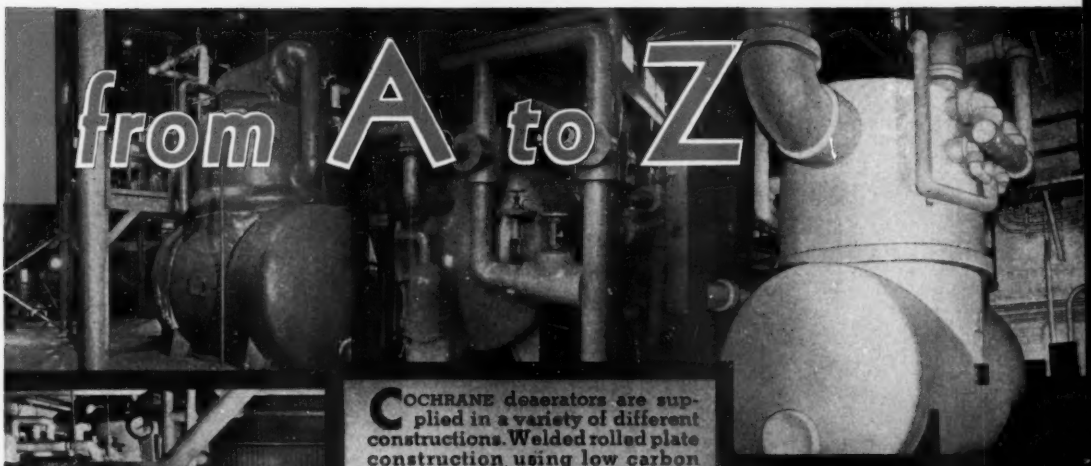
DEAERATION

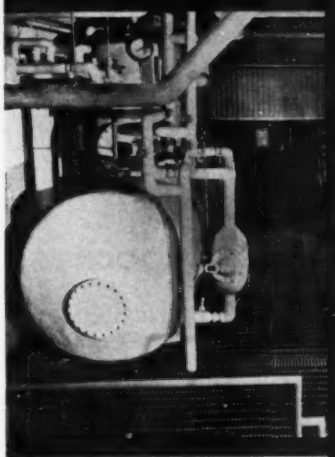


COCHRANE pioneered in the art of removing dissolved oxygen and other corrosive gases from boiler feed-water and for over six decades has been a leader in this important field. One reason for this leadership is the fact that Cochrane deaerators are designed to fit the exact requirements of the power plant or the process for which they are intended.

Tray-type deaerators are supplied for a large majority of installations. Atomizing deaerators are furnished for all marine installations and for many industrial plants where corrosive and incrusting water supplies make their use advisable. Cold water deaerators for the protection of pipe lines and heat exchangers eliminate oxygen without heating the water.

from A to Z

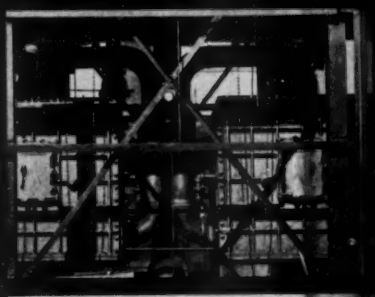


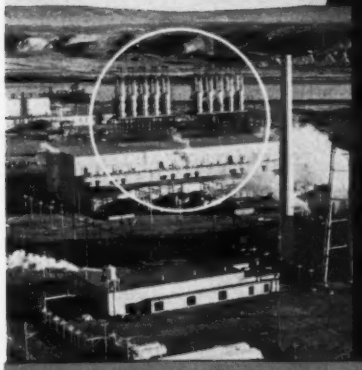


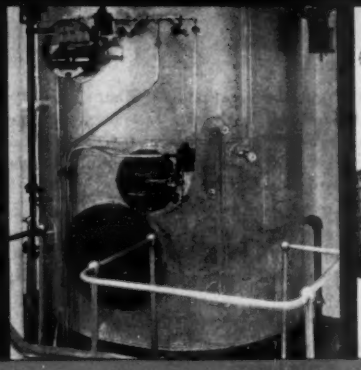
COCHRANE deaerators are supplied in a variety of different constructions. Welded rolled plate construction using low carbon steel, alloy steels and other metals is furnished for all pressures and capacities. Cast-iron shells of heavy, deeply-ridged sectional plates, with caulked joints, may also be supplied.

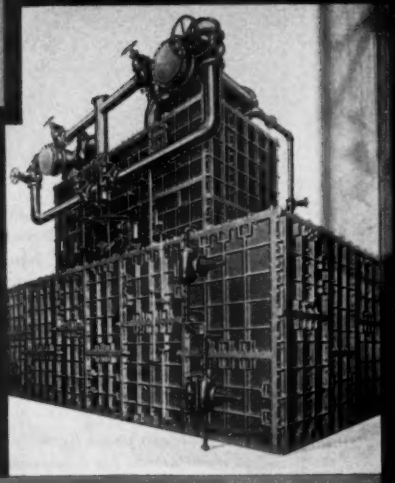
Special designs to meet unusual conditions, such as space limitations, are often necessary and Cochrane's long experience in this field invariably results in considerable savings in the cost of the power plant by obviating changes in building construction or in the arrangement of the equipment. Installations shown on these two pages are typical. Write for details.

COCHRANE CORPORATION
Philadelphia 32, Pennsylvania

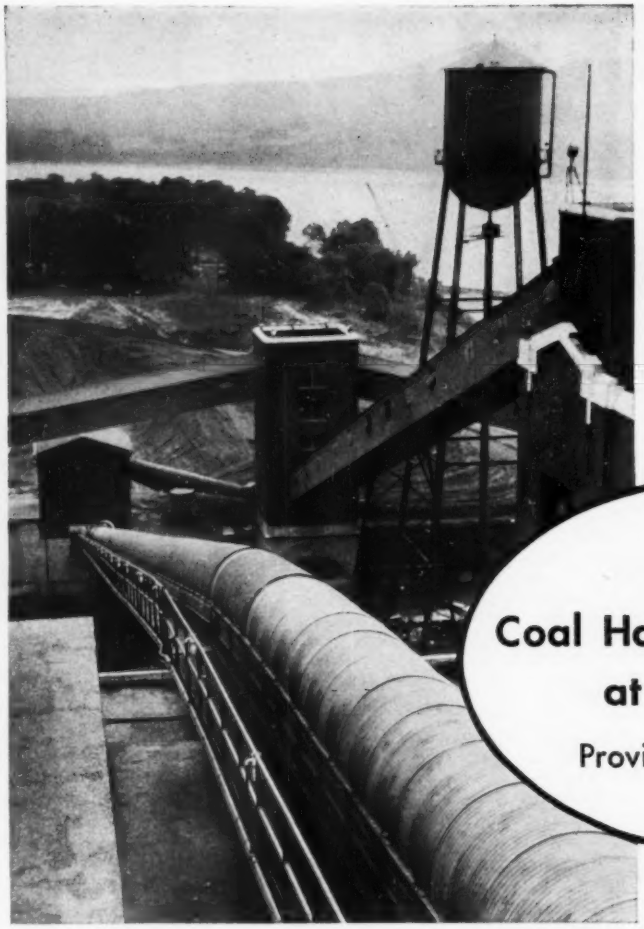








COCHRANE



NEW
Coal Handling Capacity at Cincinnati
Provided by S-A

Plant expansion at this large generating station made it necessary to install additional coal handling facilities. Low cost per ton moved was a major requisite as well as weather protection. The S-A engineered belt conveyor system, which was installed, has proved ample in efficiency and capacity.

S-A engineers are backed by a full half century's experience in bulk materials handling. For industries of practically every type they have recommended and installed systems that improve the efficiency and cut the costs of handling coal and other bulk materials.

You can profit by their experience. Invite them to offer recommendations for equipment to fit your specific needs. There's no obligation on your part . . . Write today!

CINCINNATI GAS & ELECTRIC CO.
MIAMI FORT STATION

Coal, moved from ground level storage area to crusher house, is picked up by a 410-foot long S-A Belt Conveyor and carried to the roof of the new plant building. In turn, it is delivered by cross belt conveyors into the old and new boiler house bunkers below. A protective feature of the S-A Belt Conveyors are corrugated hoods (shown in photo) which cover them. These are hinged to permit maintenance men standing on walkway to service carriers.

1901-1951

50 years experience with bulk handling

STEPHEN S-A ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

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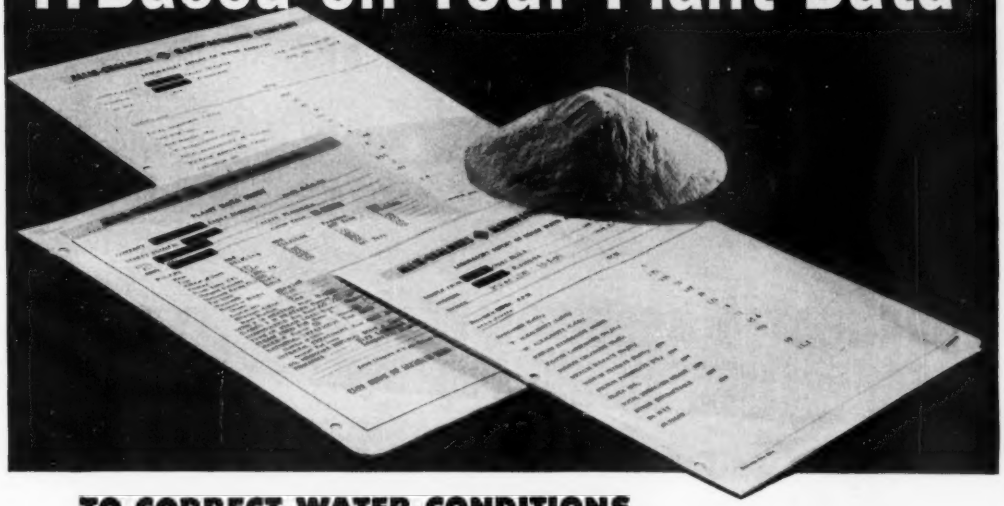
ALLIS-CHALMERS
No. 30 SERIES
Boiler Feedwater Treatment

..Based on Your Plant Data



TO CORRECT WATER CONDITIONS USE THE CORRECT TREATMENT

THE RIGHT PROTECTION in the right amount is given by Allis-Chalmers No. 30 Series powder formulations — protection against scale, corrosion and embrittlement (if required). The materials used, their proportions and the rate of feeding are prescribed by Allis-Chalmers specialists, and each formulation is based on the characteristics of the plant it is to serve.

There are no secrets connected with No. 30 Series treatments. These formulations are the logical chemicals in the proper proportions to control undesirable elements revealed by a study of your plant data. No stock "boiler compound" can equal this straightforward, effective internal treatment for boilers in the low and medium pressure ranges.

A trial period for a No. 30 Series treatment can be arranged for your plant if our studies indicate that it will prove helpful.

FOR A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 30 Series internal treatments, send for bulletin number 28X7531. If you wish, your nearby Allis-Chalmers office can arrange to have your water problem brought before our specialists for study.

Allis-Chalmers
Milwaukee 1, Wisconsin

Gentlemen:
Please send me bulletin 28X7531.

Name .....

Title .....

Company .....

Address .....

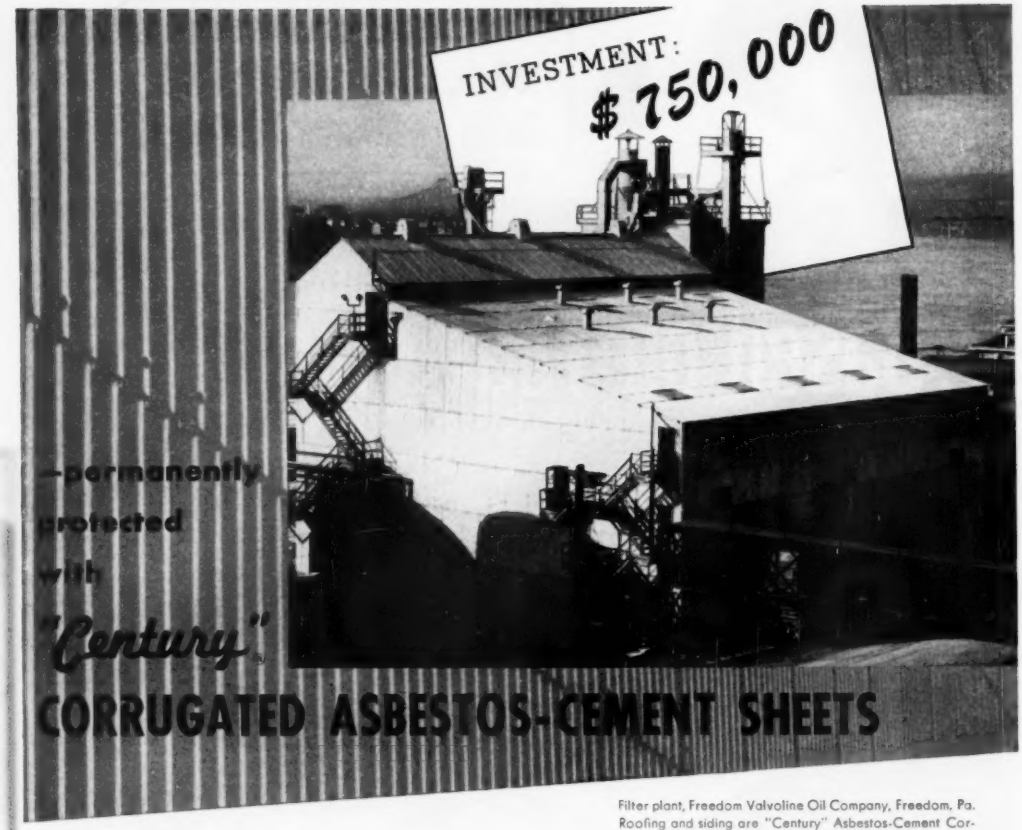
City ..... State .....

A-3376

ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE



Filter plant, Freedom Valvoline Oil Company, Freedom, Pa. Roofing and siding are "Century" Asbestos-Cement Corrugated. Erection Contractors: Elwin G. Smith & Company.

THIS modern filter plant of the Freedom Valvoline Oil Company, Freedom, Pa. is typical of the many progressive industrial plants throughout the nation where "Century" Corrugated Asbestos-Cement Sheets have been used for both roofing and siding.

The choice of "Century" Asbestos Corrugated is a logical one wherever quick application and maintenance-free service are desired. "Century" Asbestos Corrugated goes on quickly, inexpensively. The large-size sheets are exceptionally strong, but they can be cut and drilled easily—fastened in place with a minimum of labor.

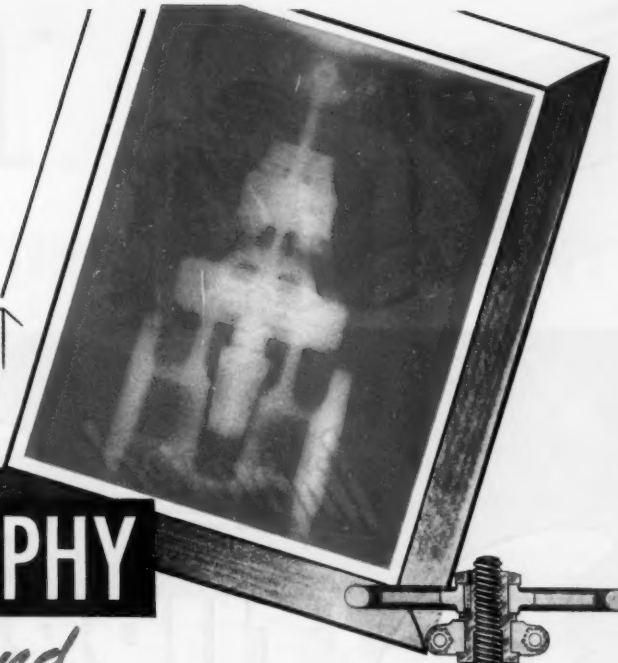
And the protection is permanent! "Century" Asbestos Corrugated resists weather; *can not burn*, rot, or rust. Rodents and termites can't hurt it. It doesn't even need protective painting to preserve it!

Whatever your building plans—new construction, modernization, expansion—get the cost-saving story of "Century" Corrugated Asbestos-Cement Sheets. We'll gladly send complete data on request.

Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

IN CANADA: ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG, VANCOUVER



RADIOGRAPHY

reveals sound

LUNKENHEIMER STEEL CASTINGS

Radiographic waves search the internal structure of Lunkenheimer steel gate valves, exposing the dense, sound quality of their castings. The smooth tone of this short-wave gamma ray photo is your final assurance of soundness in the steel valve you depend on for round-the-clock service. Other tests guard the Fig. 1751 from imperfections after every manufacturing process — from foundry to final assembly.

For service on your steam and other non-lubricating fluid lines, specify body-bonnet-trim combination WB6. Body and bonnet are of cast carbon steel, discs are 13% chrome stainless, and seat rings are high tin content nickel alloy. The same valve is also available for lubricating fluids . . . specify Fig. 1751 WB2.

The disc rises clear of the straight-through, streamlined port-to-port flow to minimize turbulence and pressure drop. Backseating faces let you repack the valve while it's wide open and under pressure.

Write for your copy of "Lunkenheimer Cast Steels," a brochure which will help you select the proper steel valves for service under any pressures, temperatures, or operating conditions. Address: The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.

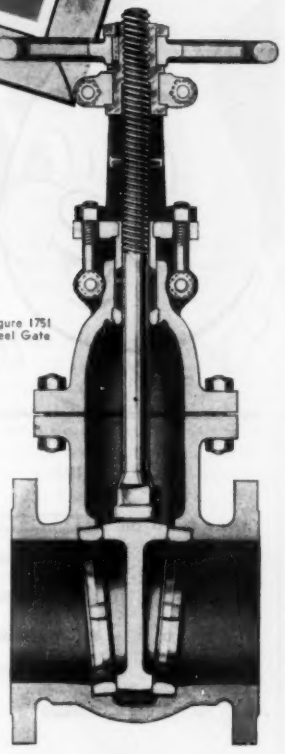


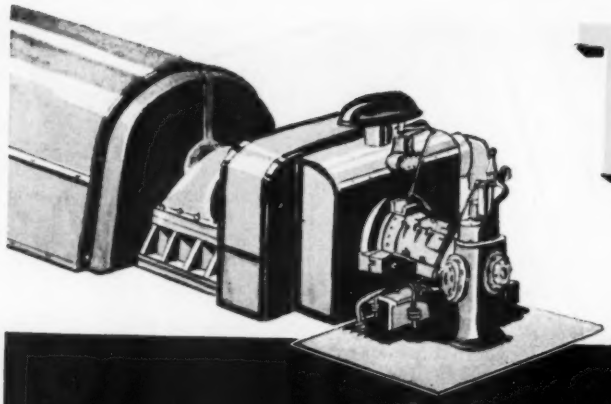
Figure 1751
Steel Gate

STEEL • IRON • BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

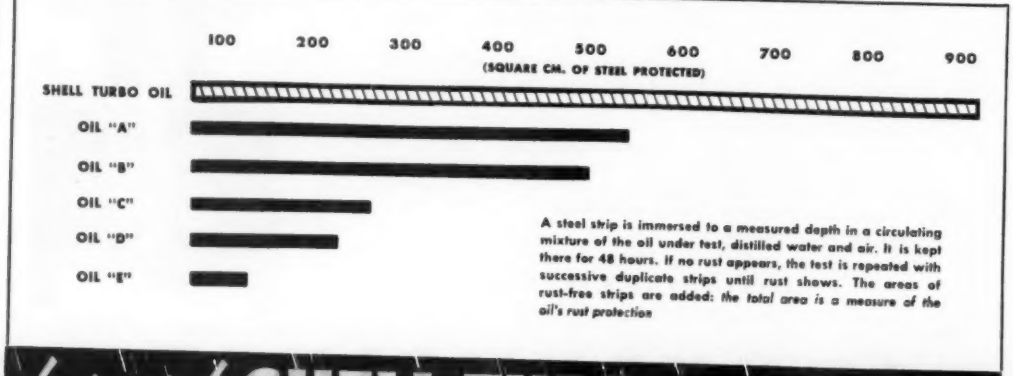
L-151-37A



Today's

Improved SHELL TURBO OIL

"LOOK AT THESE RUST-PROTECTION FIGURES"



A steel strip is immersed to a measured depth in a circulating mixture of the oil under test, distilled water and air. It is kept there for 48 hours. If no rust appears, the test is repeated with successive duplicate strips until rust shows. The areas of rust-free strips are added: *the total area is a measure of the oil's rust protection*

Improved SHELL TURBO OIL for

Surest Safeguard

for MAJOR TURBINE INVESTMENT

The one lubricant that provides this

outstanding 5-way protection

Because of the tremendous responsibility entrusted to operators of large steam turbines, and because of the heavy investment each unit represents, Shell Oil Company has been concentrating on a lubricant research project of primary importance to utility and industrial executives.

The product now offered, Improved SHELL TURBO OIL, exceeds *every* accepted specification for premium turbine lubricants. It offers these five outstanding improvements:

1. **Highest known rust protection**—An entirely new combination of rust inhibiting additives effectively retards the formation of rust—an action which with proper maintenance will continue for the life of the turbine. Rusting problems are reduced to the very minimum in any turbine protected by Improved Shell Turbo Oils.

2. **Outstanding Oxidation Stability**—Improved Shell Turbo Oil contains the same time-proved anti-oxidant which has compiled such an extraordinary record of oxidation stability in the original Shell Turbo Oil. Service records for turbine units of all sizes . . . many operating for 10 to 13 years . . . show complete stability with respect to oxidation and sludge formation. In each of these units the oil gives every indication of matching the operating life of the turbine itself.

3. **Anti-foaming**—With the effective anti-foam agent now in Shell Turbo Oil, air entrainment can be tolerated for considerable periods, thus avoiding unscheduled shutdown.

4. **Excellent Emulsion Characteristics** — Improved Shell Turbo Oil provides the greatest protection against rust and oxidation yet achieved. Moreover, this protection is attained without any tendency to form objectionable water emulsions in service.

5. **Protection against wear**—The specially developed rust inhibitor used in Improved Shell Turbo Oil has the added faculty of reducing surface wear . . . adding to the protection afforded by the Oil itself. Because of this "anti-wear" effect, Shell Turbo Oil provides a welcome margin of safety for the bearings and gears during the critical starting and stopping periods.

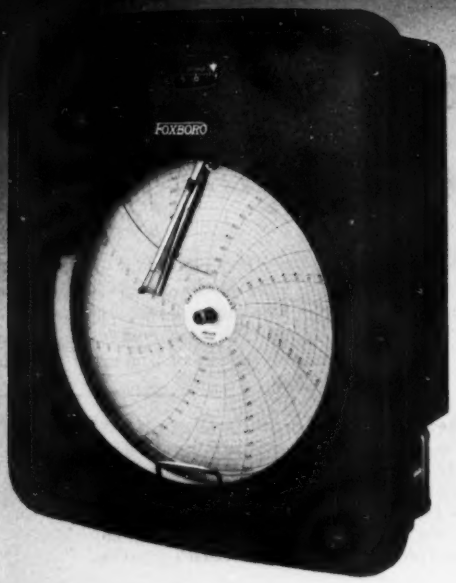
Samples and complete information on the Improved Shell Turbo Oil will be sent promptly on receipt of your letterhead request. Address: Shell Oil Company, 50 West 50th Street, New York 20, N.Y. or 100 Bush Street, San Francisco 6, California.

SHELL®

central station and industrial turbines

better measurement and control of

TEMPERATURE



−350°F to +2800°F

Throughout the vast field of industrial temperature instrumentation, Foxboro will be found in the greatest number of installations where complete reliability and most economical fulfillment of optimum accuracy are vital. If your process requires temperature measurement or control in any range between −350°F. and +2800°F., the high engineering standards and complete diversity of Foxboro Instruments . . . backed by Foxboro's unequaled application experience . . . offer you the way to obtain it most effectively.

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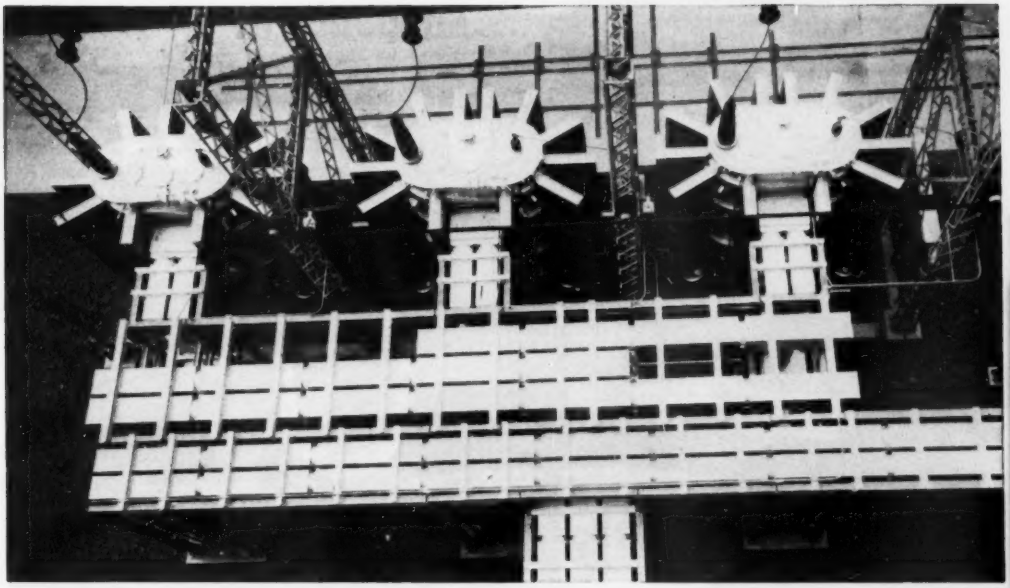
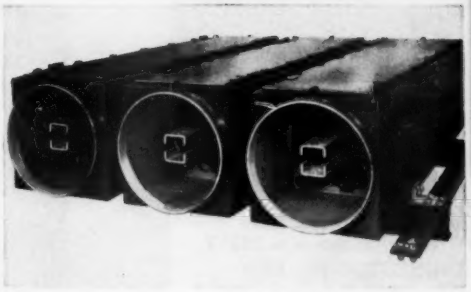
Vital Station Interconnections Get Maximum Protection



isolated-phase bus

With G-E isolated-phase bus runs for vital interconnections between generators, transformers and main switchgear, you know that every precaution is taken to insure freedom from faults of every type. Dust-tight, weather-tight aluminum construction seals out many possible causes of flashover. Advanced G-E design reduces the number of creepage surfaces without sacrifice of mechanical strength. Supplied in either individual-phase sections or as a complete three-phase package, G-E isolated-phase buses simplify installation problems and cut costs.

Your G-E sales representative has complete information. Ask him for a copy of GEA-5460, a 28-page publication that will aid you in planning your buses, or write to General Electric Company, Schenectady 5, N. Y.



Typical three-phase section of G-E isolated-phase bus. Bus is copper, channel-type to provide maximum strength. Silver contact surfaces assure full flow of current and eliminate oxidation troubles. Insulators conform to NEMA standards, are normally carried in stock in power stations. Gasketed, aluminum cover has two sets of hinges to permit opening from either side. Lugs release covers without removal of any bolts. End bells are welded to housing. Adjacent ring flanges are tightly joined by split aluminum bands whose mating edges are also gasketed.

855-26

GENERAL ELECTRIC

ARE YOU WORKING ON ANY PROBLEMS INVOLVING THE INSULATION OF PIPES? LET THIS HELPFUL FACT FINDER GIVE YOU . . .

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EXCLUSIVE DUAL TORQUE TUBE

Add a Pilot or Switch— Get Double Duty with the BS&B "Climax"

LIQUID LEVEL CONTROL!

The revolutionary new housing design of the BS&B "Climax" Type 888 Liquid Level Controls permits the use of two torque tubes with appropriate pilots or switches. One controller can operate two pilots (direct and reverse, if desired) or a pilot and a magnetic switch. Or additional electric circuits can be controlled through the use of pressure switch set in output line of pilot.

Safety alarm controllers may sound alarm gongs or klaxons, start or stop pumps, open or close colored position light circuits.

Investigate these "extras" today. Write for new, complete catalog Section 103 on the Type 888, the new liquid level controller with more than 12 years' development behind it.

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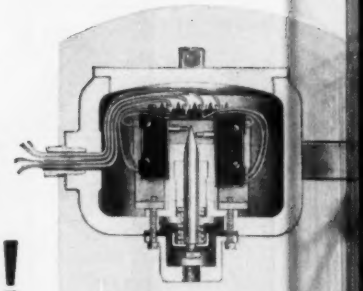
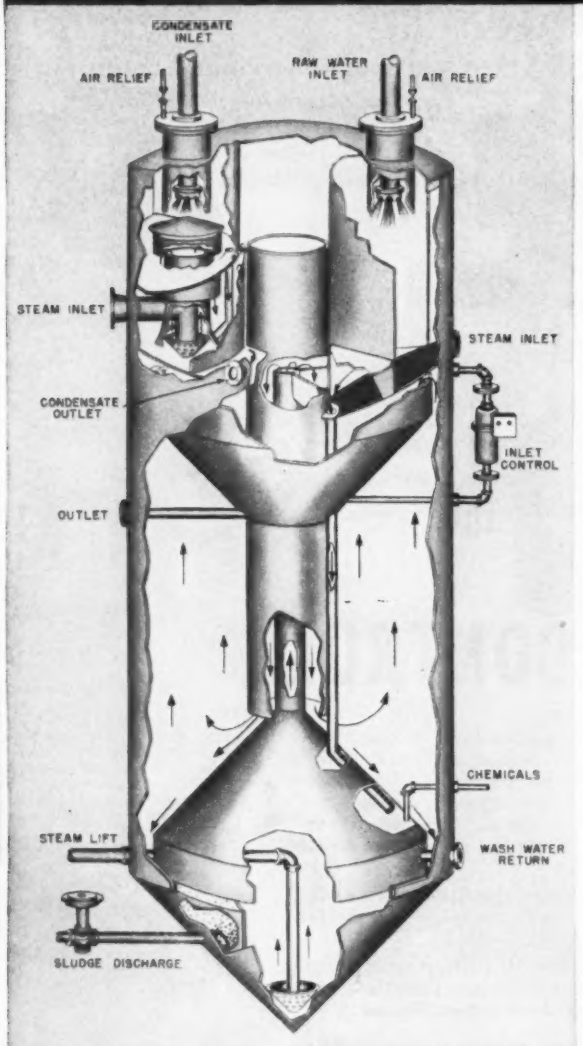


Type 2112 Explosion-Proof Pressure Switch, designed to operate as many as three circuits from any pressure source with as much as five pounds range. Unique diaphragm-operated design gives longer, trouble-free life. Gas-tight. Easily wired and mounted.

Type 2122 Magnetic Switch utilizes the turning movement of the Type 888 torque tube to actuate switches. Sensitive to a minimum change of 10% of the length of the displacement element. Explosion-proof cover. Mounts easily on any BS&B "Climax" liquid level control.

BS&B "Climax"
DISPLACEMENT LIQUID LEVEL CONTROL and SWITCHES

The Hot Process ACCELATOR®



MULTI-PASS TREATMENT FOR

- ***Softening***
- ***Silica Reduction***
- ***Deaeration of Makeup and Condensate***

HERE'S THE ANSWER TO 3 OF THE POWER ENGINEER'S MOST COMMON PROBLEMS

SOFTENING: Positive internal slurry recirculation insures maximum softening, alkalinity reduction, and turbidity removal with a minimum of chemical expenditure. A steam lift effects the recirculation thereby eliminating mechanical pumping devices. A storage compartment within the tank holds sufficient treated water to handle momentary peak demands.

SILICA REDUCTION: Prolonged contact of the water undergoing treatment with the recirculating slurry as well as the redissolving of magnesium in the slurry, reduce silica to a new low.

DEAERATION: The steam lift effectively deaerates the makeup water undergoing treatment, thereby eliminating the need for separate deaerating mechanisms. The condensate enters a separate chamber in the upper portion of the tank and is recycled and scrubbed by its own steam lift system.

Check these advantages of the Deaerating Hot Process Accelator: 1. Self-contained deaeration for both makeup and condensate, 2. Controlled slurry recirculation, 3. Maximum silica reduction by the redissolving of magnesium, 4. Reprecipitation for chemical economy, and 5. An effluent low in turbidity, alkalinity, and hardness. Investigate the new Deaerating Hot Process ACCELATOR. Write for complete information, now.

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• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

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SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

Power
COMBINED WITH OPERATING ENGINEER

Meet the Lubrication Engineer

AT THE RECENT PHILADELPHIA MEETING of the American Society of Lubrication Engineers, W L Lewis, vice-president of International Business Machines, outlined the lube plan that is saving money for IBM. Establishing a separate department to plan and supervise the lubrication of all production tools and plant machinery has cut their yearly cost of lubricants and reduced machine outage.

These savings all stem back to smart organization. IBM picked a topnotch wide-awake man to head this new department with the title of Lubrication Engineer. *All lubrication* is his bailiwick. Old-time hit-or-miss "oilers" have been abolished at IBM. The 25 or so "Machine Servicemen" who report to the Lubrication Engineer are trained technicians, miles ahead of the old traditional oil slingers.

And this is just one instance of what is happening in progressive outfits.

You may ask just what a lubrication engineer does for his salary? Here are some of the ways he saves dollars for his company:

Working closely with the supplier's experts he figures out the lubrication requirements of each machine, lays out a lube schedule for the whole plant, standardizes on a small number of lubricants, and considers the economies of bulk deliveries.

The schedules show not only when to lubricate but also how much, remembering that too much wastes oil and may also put motors, for example, out of commission.

The lubrication engineer standardizes on lubrication devices, investigates failures, and works closely with the manufacturers of new machines. He makes sure their lube systems will mesh with the master plan of his plant.

In larger plants, the lube engineer will often run his own laboratory tests of lubricants.

If you'd like to capture some of the benefits of engineered and managed lubrication, remember that the most important thing is to pick the right man and give him the authority, the staff and the facilities to do a real job.

And by all means encourage him to share the best thinking and experience of the field by joining the American Society of Lubricating Engineers. This vigorous young society is coming up fast, with 1700 members and 23 sections throughout the country. For more information write the ASLE National Secretary, W F Leonard, 343 S. Dearborn Street, Chicago 4, Ill.

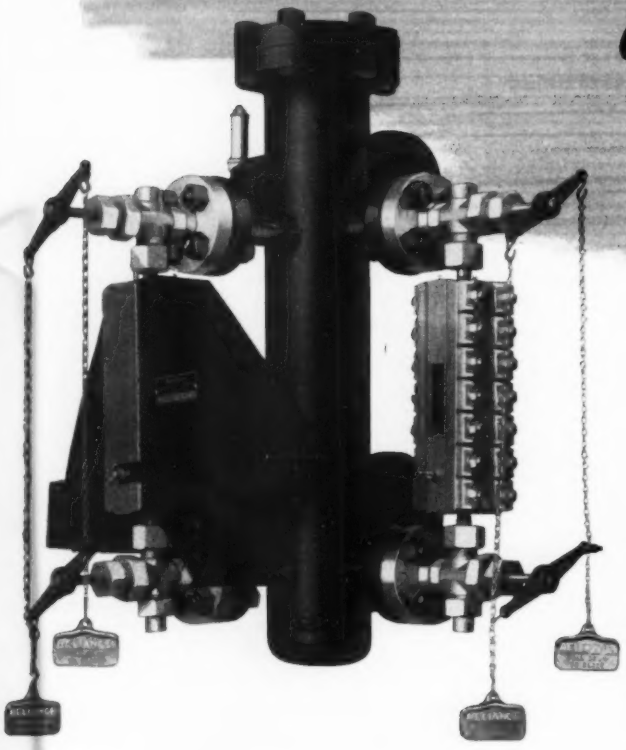
To sum up, lubrication is becoming a managed function. The lubrication engineer is taking over. His men are trained technicians, not mere "oilers."

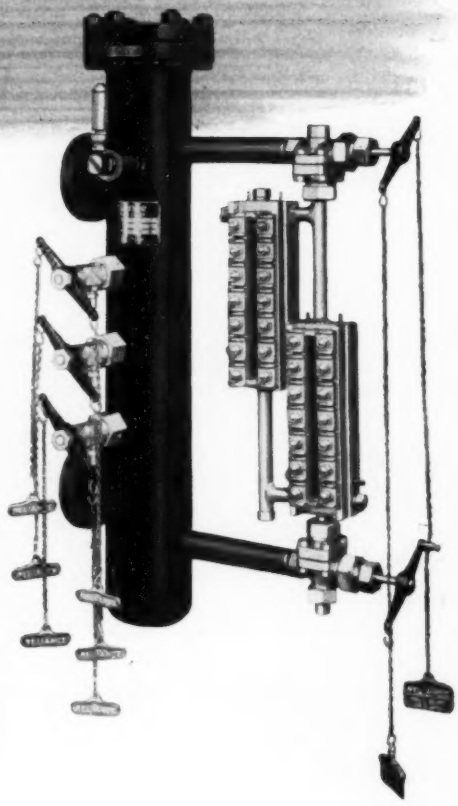
All this would be a sound way to save money even with the limited machine demands and lubrication knowledge of a decade ago. It's much more important today with bearing loads, speeds and temperatures climbing. And oils and greases are more complex; many additives now cope with new and some old conditions.

Yes, it will pay you to set up a lube plan in your plant that fits into today's engineered and managed lubrication picture. And don't fail to get the right man to run it!

RELIANCE WATER COLUMNS

for any working steam pressure assure you the *utmost*





Reliance Boiler Safety Devices include Water Gages and other trim for all working steam pressures. Also EYE-HYE, the original all-hydrostatic remote reading water level indicator.

The name that introduced safety water columns...

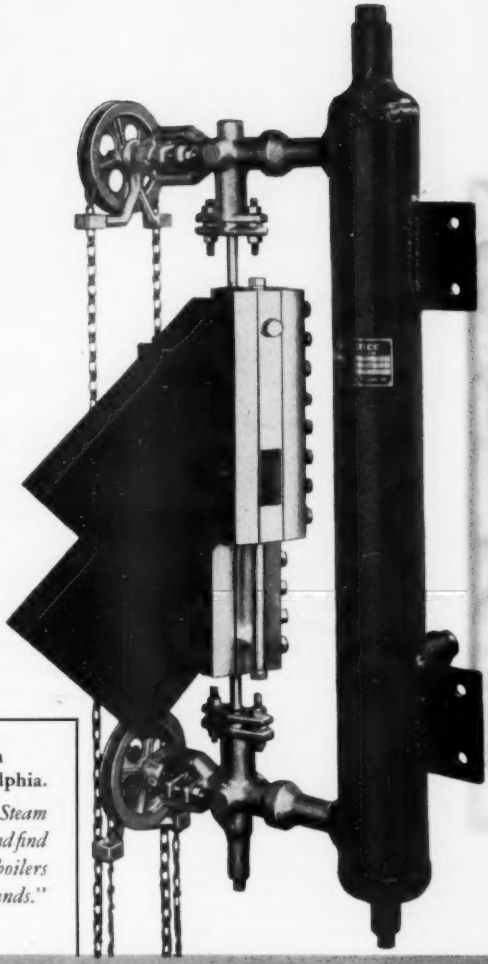
in Dependability

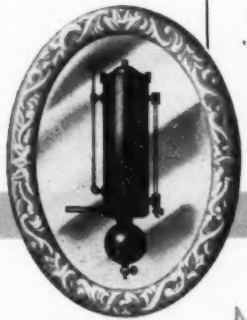
SINCE 1884, Reliance has maintained leadership in Boiler Safety Device development and manufacture. Water Columns with automatic Alarms, operated by the original *instantaneous* alarm mechanism, have helped to fortify power plants against the consequences of boiler water failure for billions of operating hours. Alarms are available on columns for pressures to 900 psi.

For higher pressures, Reliance provides standard and custom-built equipment that embodies principles of design and construction perfected in 67 years of *specializing* in this field—"super-rugged" Water Columns built with a generous extra margin of safety.

Selected as standard equipment by many boiler manufacturers and consulting engineers, Reliance Water Columns exceed the requirements of national and state code authorities. Check with your consultants or ask for our nearest engineer representative.

THE RELIANCE GAUGE COLUMN COMPANY
5902 Carnegie Avenue • Cleveland 3, Ohio





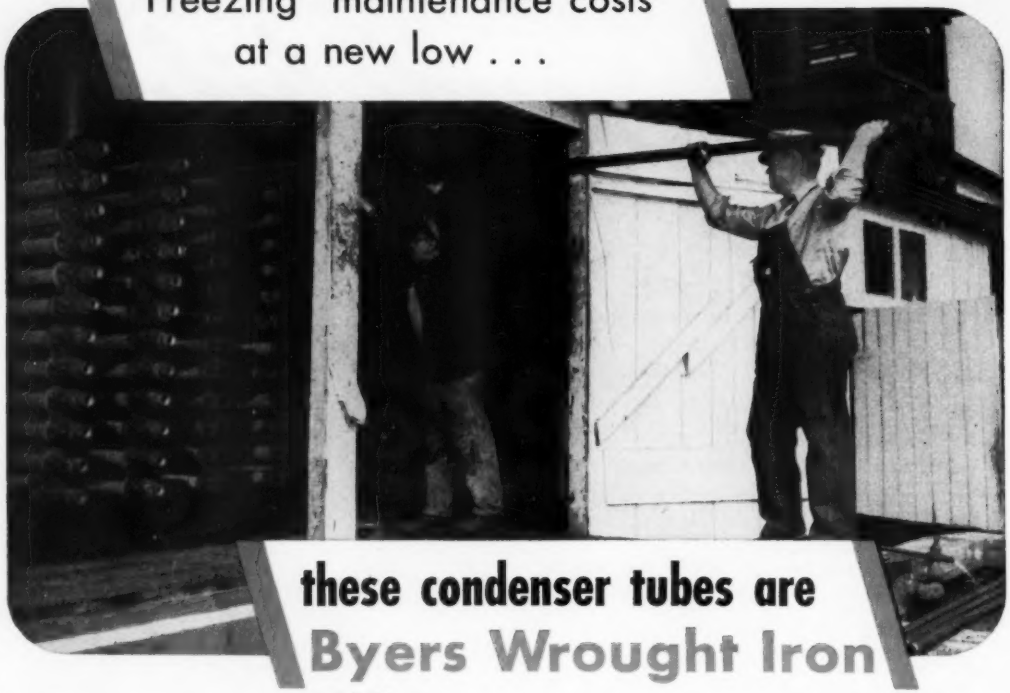
Letter dated May 29, 1896 from
Kalion Chemical Company, Philadelphia.

"Gentlemen: We have equipped our entire Steam Plant with your Safety Water Columns, and find them perfectly satisfactory. One of our boilers has a working pressure of over 175 pounds."

...in 1884 ⇨ **Reliance®**

BOILER SAFETY DEVICES

"Freezing" maintenance costs at a new low . . .



these condenser tubes are Byers Wrought Iron

Because pipe was difficult to get in 1947, the Colonial Ice Company had to use anything that was available for re-tubing the condensers at their Rocky Mount, N.C. Plant. As a result, some of the tubes failed after a comparatively short period of service. In writing up the specifications for the replacement tubes, J. B. Huff, the Company's Chief Engineer took definite steps to forestall premature failure in the future by selecting genuine wrought iron for this highly corrosive service. Over four tons of Byers Wrought Iron was used.

If you are using low-first-cost materials in your condensers and are bothered by frequent repairs, you may find a source of substantial savings by using genuine wrought iron. This material has been favored in refrigeration plants for decades, and users have reported some remarkable service records. In many instances, other piping or tubing materials had also been used, giving a direct comparison of service under identical conditions, and genuine wrought iron was usually reported as lasting two to three times as long.

Our bulletin, WROUGHT IRON IN REFRIGERATION AND AIR CONDITIONING SYSTEMS, will give you some helpful information. We'll be glad to send you a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unusual fibrous structure of genuine wrought iron—which is responsible for the unusual corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

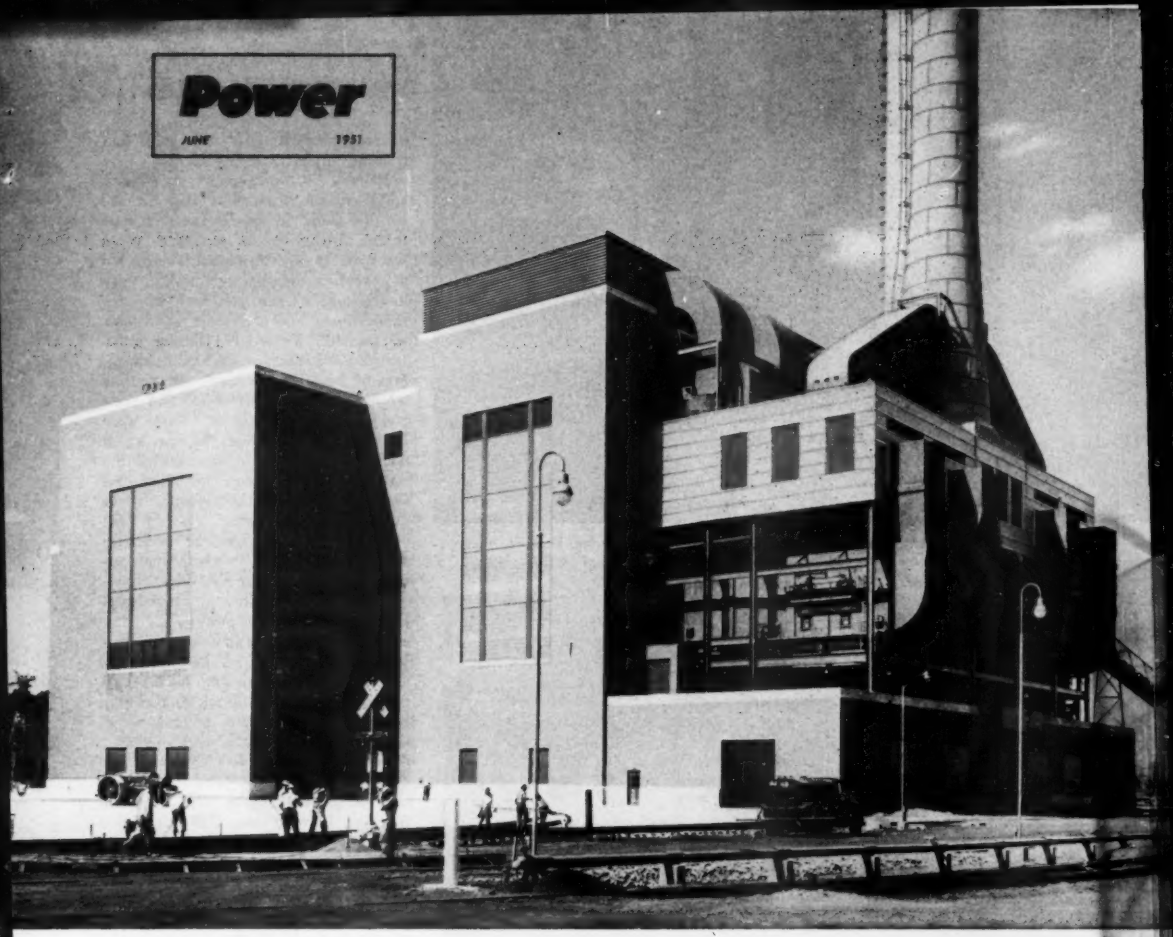
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Power
JUNE 1951



BARBADOES EXTENSION has two 600,000-lb-per-hr steam generators, each supplying a 60,000-kw preferred-standard turbine

Equipment Standards Cut Costs and Erection Time

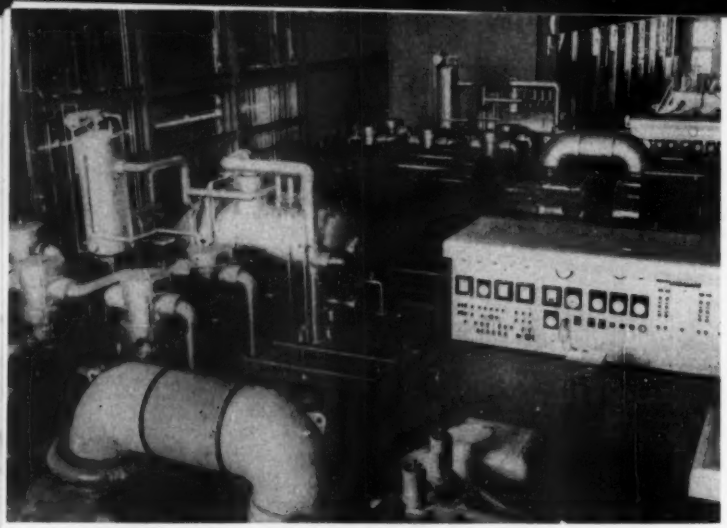
WHAT SHOULD POWER-PLANT DESIGNERS DO WHEN FACED WITH RISING COSTS, MATERIAL SHORTAGES AND PRODUCTION BOTTLENECKS? HERE'S WHAT PHILADELPHIA ELECTRIC CO DID

By D F SCHICK and J R NEVINS, *Philadelphia Electric Co*

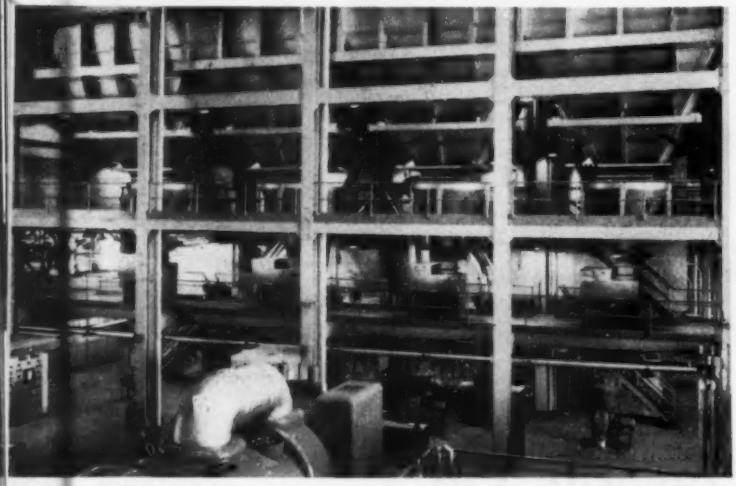
► LOOKING OVER the latest Barbadoes units, No. 3 and 4, you will find that much of the equipment conforms to standard specifications. This contrasts with the practice in many stations of issuing specifications to meet special requirements. Standardizing lowered the first cost of the plant and let us realize definite time savings which was a major consideration.

Philadelphia Electric had to expand Barbadoes when materials were short and deliveries long. Selecting standard equipment helped to ease the pinch and saved money to boot.

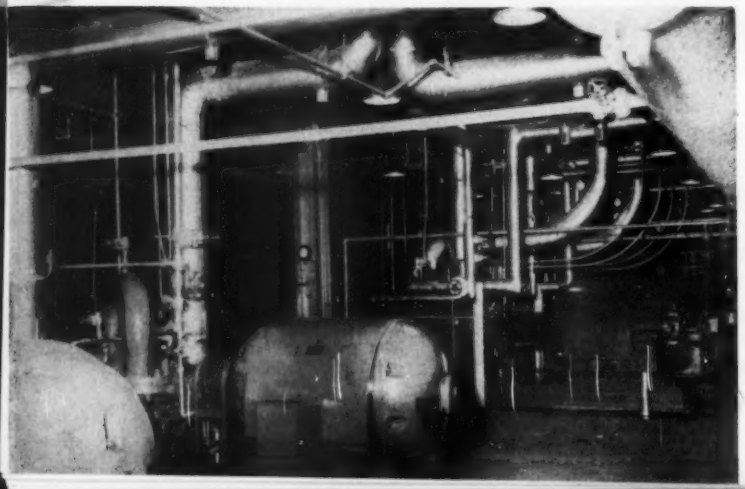
Turbines. No. 3 started commercial operation on March 11, 1949, and No. 4 on June 11, 1949. We gained advantage by choosing preferred-standard units, 60,000-kw in this case. These standards were announced in 1945 by a joint committee formed by the AIEE and ASME. Manufacturers immediately



TURBINE HALL in Barbadoes Extension accommodates main units, heaters, evaporators, control boards for both turbines and boilers. Steam supplied at 850 psig, 900 F



BOILER FRONTS and coal feeders face directly into turbine hall with no intervening division wall. Boilers burn pulverized coal, oil or natural gas as desired



WHERE STANDARDS APPLIED . . .

offered standard units at a price and time advantage.

Boilers. Unfortunately no boiler standardization parallels that in the turbine field. So we did the next best thing. Advantages of standards come wholly from repetitive manufacture. We discovered a neighboring public utility had bought a steam generator with the same steam and feedwater conditions we wanted. We ordered similar units. In a limited way this was taking advantage of available standards. At the time we ordered, detail drawings had been completed by the builder. These were used for the Barbadoes boilers, which were built to meet regulations of the ASME Boiler Construction Code and the Commonwealth of Pennsylvania Codes and Regulations.

Standards. Throughout the station we adhered to standards, whether of the national type, such as American Standards Association, Inc. or individual manufacturers and power company standards. There are an enormous number of standards; ASA has approved about 1124. On analyzing its list and comparing them in detail with utility specifications we found many applications existed. Here are some of them:

American Standards A:

Civil Engineering and Construction: includes Cements, Fire Tests of Building Construction, Building Exits Code, Building Construction Safety Code, Scheme for Identification of Piping Systems, Plumbing Code, Co-ordination of Dimensions of Building Materials, etc.

American Standards B:

Mechanical Engineering: includes Unified and American Screw Threads for Screws, Bolts, Nuts and other Threaded Parts; Pipe Threads, Cast-Iron Pipe Flanges and Flanged Fittings, Steel Pipe Flanges and Flanged Fittings, Code for Pressure Piping, Welded and Seamless Steel Pipe, Lap-Welded and Seamless Steel Pipe for High-Temperature Service, etc.

American Standards C:

Electrical Engineering: includes Rotating Electrical Machinery, Power Circuit Breakers, Transformers, Current Limiting Reactors, Electrical Conductors, etc.

Let's look briefly at how some of these codes were formed. In group *A*, for example, it had been evident in the building industry that important advantages would be gained if brick, stone, masonry, blocks, steel, etc, were

←

EACH BOILER-TURBINE UNIT has its own set of boiler feed pumps; no interconnections are made between boilers, turbines, steam and feedwater systems

...TO BARBADOES EXTENSION

co-ordinated with dimensions of windows, doors and other wall-opening materials. This led to writing *A* 62.1-1945—*Coordination of Dimensions of Building Materials and Equipment.*

In group *B* the need for a national code on pressure piping led to issuing an American Tentative Standard in 1935. High-Pressure Piping, including High-Pressure Steam Mains, High-Pressure Boiler Feed, Soot Blower Piping and Steam Piping to Auxiliaries are all in accord with the latest ASA *Code for Power Piping, B,* 31.1.

In group *C* it had been found, for example, that manufacturers had to produce circuit breakers in a large range of ampere and interrupting ratings to meet individual orders. This was costly because of custom-building procedures needed. By developing ASA Standard *C* 37.6-1949—*Preferred Ratings for Power Circuit Breakers*—ratings were limited to those in most general demand. This code has materially reduced overall cost of manufacture.

In addition to these codes we had to observe governmental standards, such as the *Pennsylvania Boiler Code* and the *Commonwealth of Pennsylvania Codes and Regulations.*

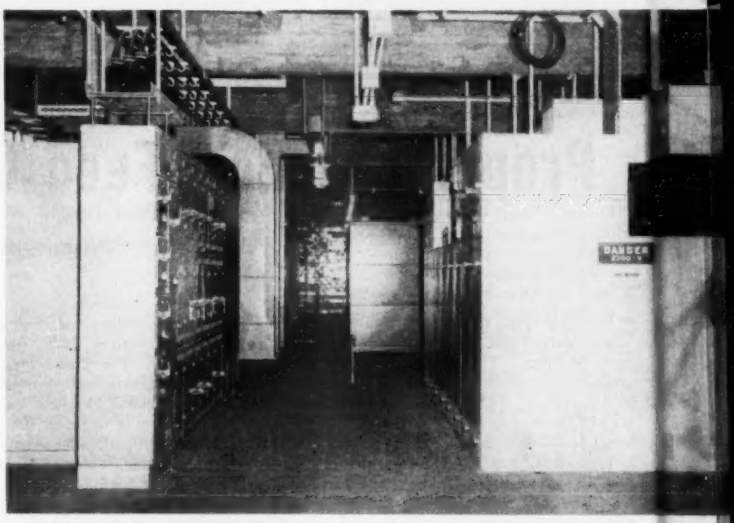
Standards approved by the ASA represent agreements among manufacturers, sellers and users on best industrial practice. These standards, used throughout the Barbadoes specifications, saved in both time and money by speeding up equipment production.

Over 1000 drawings were made for this project and these, too, conform to American Standards Z—*Miscellaneous Symbols and Abbreviations and Graphical Symbols. Standards* Z 32.2-1941 *and* Z 32.3-1946—*Graphical Symbols* for drawings in mechanical and electrical engineering applied to our project.

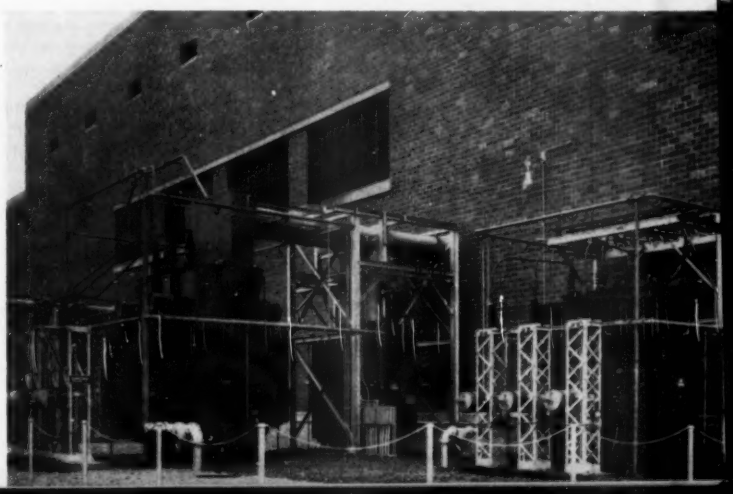
This detail of application can be found in each specification written for the project. There were 96 mechanical and 16 electrical specifications issued separately.

We used a number of standards compiled by different agencies. This might be considered confusing, but each one represents combined experience of user and manufacturer. The ASA Standards were formed so as to have one American Standard. They are usually produced after suitable and acceptable standards have been adopted by other organizations.

ELECTRICAL CONTROL ROOM for main generators and switching uses uniformly illuminated ceiling to avoid casting shadows on panels, achieves maximum visibility

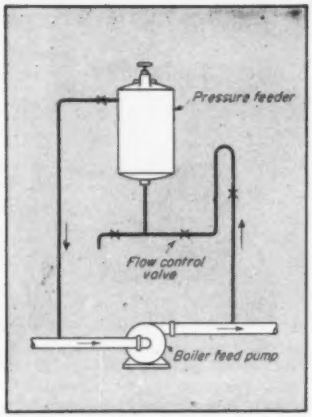


AUXILIARY-POWER SWITCHGEAR controls energy taken from 13.8-2.3-kv transformer, connected solidly to main generator leads, through metalclad-type buses

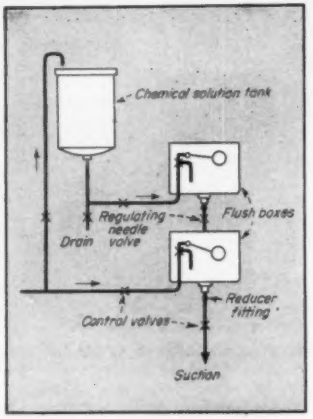


MAIN AND AUXILIARY TRANSFORMERS tie solidly to generator terminals; general station-auxiliary transformers connect to station single 33,000-volt bus

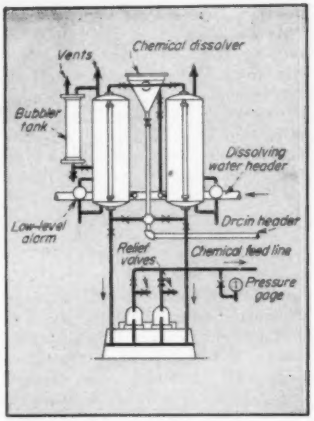
CHEMICALS ADMITTED AT THE PREBOILER CYCLE NEED SPECIAL EQUIPMENT . . .



1 Simple pot-type chemical feeder requires a slow-dissolving treatment



2 Gravity feed under constant pressure gives good service with deaerators



3 Some chemicals must have pumps to assure a continuous-treatment result

Proper Chemical Feed Gets Results

By **SHEPPARD T POWELL**, *Chemical Engineer, Baltimore, Md.*

► BOILER-WATER TREATMENT and the way chemicals are fed divide into two main problems. The first involves the preboiler system, which takes in boiler feed pumps, piping, different-stage heaters and the economizer; the second, the boiler cycle itself. Because temperatures and pressures run much lower in the preboiler system, the way the chemicals react and how you put them into the system are different from boiler-cycle conditions.

For example, when you add a soluble orthophosphate to feedwater you may be heading for trouble. If even a slight trace of calcium is present a hard crystalline scale forms in stage heaters and economizers. Yet this same chemical in the higher pH, as well as higher temperature conditions of the boiler cycle, gives a flocculent, soft precipitate.

What, then, is the main job of chemicals in preboiler systems? Their work can involve: (1) lowering pH to prevent the scale, discussed above, from forming in the stage heaters and economizers—pH of 8.0 or lower is advised (2) raising pH to retard corrosion of pumps and piping (3) inhibiting deposit formation by using polyphosphates or organic chemicals.

The only way you can add phosphates to the feed system, with some chance of escaping scale troubles, is to feed them intermittently. The flushing action between treatments may prevent scaling. But, in general, the best way to handle phosphates is to inject them directly into the individual boiler drums. This way you avoid the problems caused by different loads, or blow-down schedules carried by individual boilers.

Polyphosphates that hydrolyze slowly can be added continuously to feedwater. But only if their stay in the preboiler system is short enough so they can't be converted and precipitated. Allowable time of stay depends on pH, temperature and hardness in the feedwater.

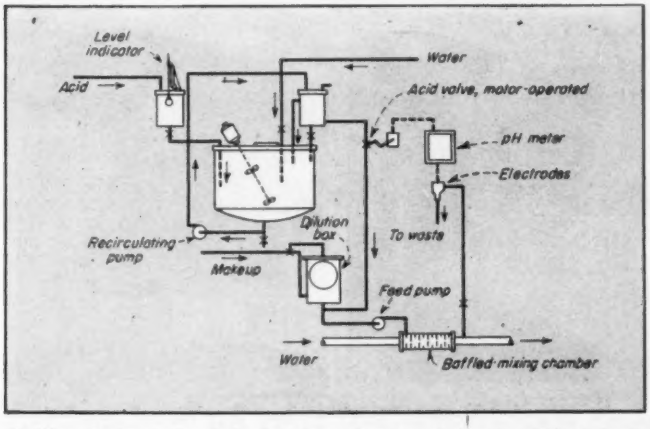
What about the equipment for feeding these chemicals? First, remember that often chemicals added to the preboiler system are meant for boiler-cycle service. That is why we mentioned the difficulties that phosphates can cause in the preboiler system. In general, chemical-feeding equipment is much simpler and less expensive than that for boiler cycle service. One of the simplest, the pressure pot, Fig. 1, usually has the chemical compounded, briquettes or balls, in a pressure container. The chemical has to be in a form that dissolves slowly as the water flows through the pot. The injection water is taken off from the discharge side of the boiler feed pump and returned to the suction side.

A similar "shot" feeding device is equipped with a filling funnel. The treatment is first dissolved in a bucket and poured in through the funnel. Such a device can be connected to a manifold and valved to a number of boilers where water-treatment correction need not be too frequent or time consuming.

Gravity Feed. Sometimes it pays to add the treatment-chemical solution to a feedwater surge tank or the deaerating heater's storage tank. Fig. 2 is a homemade assembly of porcelain flush tanks that work this way. A solution like sodium sulfite or caustic soda comes in from a mixing tank to a float-controlled valve in a constant head box. From here it passes through a calibrated needle valve to a second tank where a larger flow of diluting water is introduced under a float control. This extra flow helps establish a constant-pressure condition for the final control valve, feeding the chemical to the system. Tight-fitting lids on all tanks slow up unwanted diffusion of atmospheric oxygen.

Continuous Pumping. Some chemicals

...DIFFERENT FOR SINGLE SHOT OR CONTINUOUS FEED



4 When feeding acid to boiler feedwater, close control over the pH level should be set up to safeguard the preboiler cycle against any acid attack at all times

Most chemicals in feedwater-treatment work are meant for duty in the boiler cycle. Yet they can cause unexpected troubles in the preboiler system. Here is expert advice on how to avoid these troubles by using proper equipment and controls

have to be added continuously to avoid peaks and valleys of concentration. Sodium sulfite used for chemical deaeration, in particular, suffers with the "shot" treatment because it seems to decompose before it can do its job. A second chemical, caustic soda, for maintaining a noncorrosive pH has to be added continuously. As a result special pumps for this duty are in the market.

Fig. 3 shows a complete, continuous-pumping system for chemical feed. Small, direct-piston-displacement, metering-type pumps deliver the solution at an adjustable rate fixed by boiler-water analyses and feedwater pH. The closed tanks avoid oxygen entrainment. Displacement air for the sulfite solution goes through a small bubbler seal on the side of the tank. The solution is drained and refilled each time the tank is charged.

This figure shows a dissolver that has been found very satisfactory. A valve closes the bottom opening and the desired weight of chemical is added. Hot water directed toward the apex of the pyramid by a high-velocity jet dissolves the chemical rapidly. The solution overflows through a strainer at the top of the hopper into the appropriate tank and, by the time it is about two-thirds full, all the chemical is dissolved and the hopper should contain clear water. Water remaining in the hopper is then drained to the sewer and the solution tank filled through a tangential inlet line, which dilutes the concentrated solution to the proper strength. A comparable assembly uses tanks with removable covers and a surface float to protect the sulfite.

Acid-Feeding Equipment. If it is necessary to feed acids to lower the pH or alkalinity of boiler feedwater, equipment has to be carefully designed to safeguard personnel from injury and the feedwater system from acid attack. Although it may be possible to proportion the acid feed to flow and keep it adjusted within a safe range, it is best to introduce pH control. Equipment shown in Fig. 4 is designed for this purpose. The feedwater line contains a flanged rubber-lined section with monel baffles as the acid-mixing chamber. A flowing sample is taken immediately downstream from the mixer to a vessel housing glass and calomel electrodes connected to a pH recorder-controller. This is set for a control point of, say, 8.5 to 9.0. The controller operates a motor-driven mechanism connected to a Duriron plug cock. This, in turn, is supplied with dilute acid (5%) from a constant head box. Should the pH rise above the control range, the valve opens wider and delivers more acid. If it falls below, the valve reduces the feed. The dilute acid is continuously recirculated to a lead-lined constant head tank and overflows to a larger lead-lined storage tank.

Success of a pH-controlled acid feeder in maintaining a steady nonhunting pH level depends on reducing to an absolute minimum the time interval between pH detection and injection of the corrective acid feed. Otherwise, the control is constantly attempting to compensate for a condition that no longer exists. To reduce time lag, the sampling line to the electrode should be short and the velocity high, bypassing some of the sample, if necessary, to accomplish the desired control. Acid must be injected, along with any needed dilution water, at a velocity that will minimize the time interval between valve movement and change in water treatment. Also, detention in the baffled mixing chamber must be the minimum for thorough mixing. A total of 15 seconds between sample take-off and acid injection will assure good regulation.

One automatic type of acid feeding is based on a variable-speed pump drive operated on direct current through an electronic rectifying circuit. Rate of chemical solution discharge is actuated by dc variable-speed motor through an electronic circuit. Control is varied in proportion to the amount of water metered. For example, the assembly includes a variable-speed resistance or potentiometer that governs the speed of the pump, so the chemical feed is directly proportional to the flow. Feed of the chemical solution is adjusted by a secondary variable introduced by changing the pump stroke through a micro-drive attachment operated by a small reversible motor. A pH recorder-controller provides this secondary regulation. For example, when feeding acid where the change in the flow of the treated water is too rapid for response by a pH controller alone, the compounding of flow-proportioning control, in addition to the pH regulation, assures accurate and positive adjustment and feeding of the chemical solution.

WATCH FOR . . .

Part II of the New Power Handbook scheduled for the July issue.

SPRINKLERS ON DUTY . . .

11:30 PM Sprinkler heads mount on piping filled with water under pressure, are alert, ready all during day, night

FIRE BREAKS OUT . . .

11:35 PM Heat shoots up, raises temperature of nearest sprinkler to 135 F or higher (determined in its manufacture)

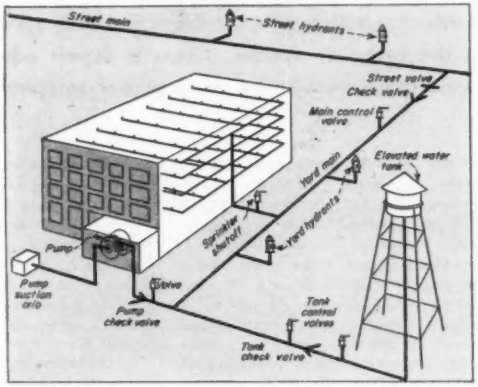
WATER CHECKS FIRE . . .

11:37 PM Opened sprinkler head releases water on fire . . . and fire area only. If necessary, next sprinkler opens, too

Sprinklers Make Plants Fire-Safe

You hope they'll never have to operate but if they must you want perfect performance. While it's a tough requirement it can be met. Here's know-how, procedures and details for the job

By **DAWSON POWELL**, *Technical Editor, and*
LT COLONEL J B COLEMAN, *Chief Engineer*
Fire Protection Division, Grinnell Company, Inc



1 LAYOUT of automatic sprinkler system shows primary and secondary water supplies. Follow NBFU standard in design

► AUTOMATIC SPRINKLER SYSTEMS are installed in a building with the hope they'll never have to operate. But if fire does occur—even 25 or 50 years later—the system must be ready for instant use. This is almost an unparalleled requirement calling for engineering experience and materials quality of highest order. System design is of utmost importance because effectiveness, cost, appearance and ease of setting up all depend on it.

Why Sprinklers? Once you know the facts, you'll never question that automatic-sprinkler fire protection is a must. Briefly, some of these are: (1) Two out of five burned-out businesses never start again, regardless of insurance coverage of property loss. (2) Not a single human life has ever been lost by fire in a hotel completely protected by automatic sprinklers. (3) Records over the years clearly show that so-called fireproof or fire-resistant construction doesn't make a building fire-safe. (4) Insurance premium savings on sprinklered property over a period of years pay for system and represent a generous return to the owner on his investment in system.

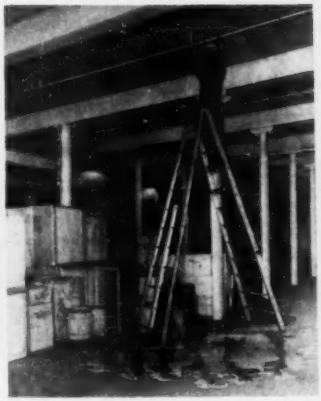
Many worth-while results are obtained by planning an automatic sprinkler system for a building during early design stages. Initial cost of the job is reduced, appearance improved, and maximum protection obtained. Let's see what is good practice in sprinkler-system design and how we can follow it on our jobs.

System Details. An automatic-sprinkler installation is essentially a system of piping just below or concealed in the ceilings, extending within effective distance of every space where fire could start. Fig. 1 shows a typical industrial-plant layout. Mounted at specified intervals along the piping are heat-actuated discharge valves or sprinkler heads.

FIRE OUT, WATER OFF . . .

11:42 PM Sprinkler head has put out fire. Watchman, summoned by automatic sprinkler alarm, has shut off the water

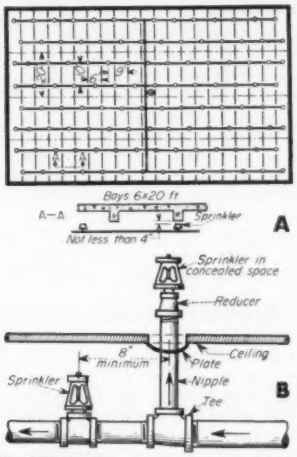
SPRINKLERS REPLACED . . .



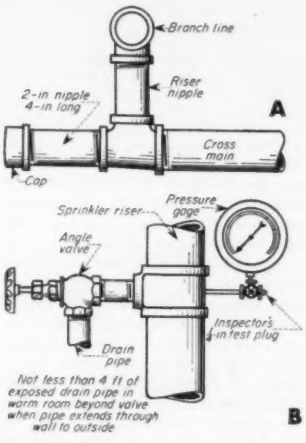
11:52 PM With the water shut off temporarily, the opened sprinkler head is replaced in a few minutes; water let back

BUSINESS AS USUAL . . .

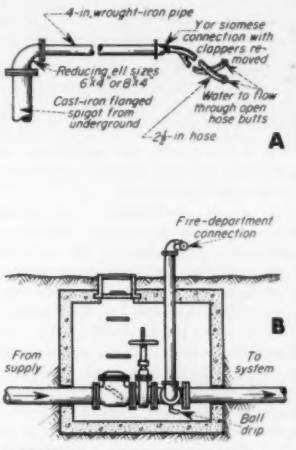
8:00 AM The fire has been put out at its start. Loss is negligible. In over half the fires only one or two heads open



2 SPRINKLER spacing in fire-resistive building, *A*. Riser nipple setup, *B*



3 FLUSHING connection, *A*. Drain connection of sprinkler-system riser, *B*



4 METHOD of flushing supply pipe, *A*. Gate, check, fire dept tie-in pit, *B*

These open when heated and permit local application of water of about the intensity of a heavy rain on the burning material; see six photos, *above*.

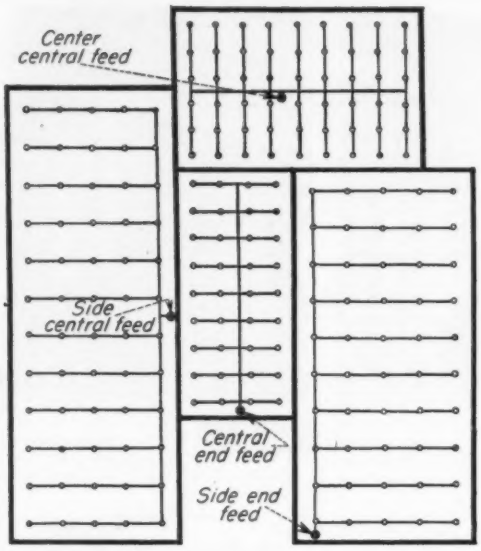
Sprinkler-system installations must comply with standards of the National Board of Fire Underwriters or the rules of the inspection department of the Associated Factory Mutual Fire Insurance Companies. These include the fundamental recommendation (Standard No. 107 of NBFU Pamphlet No. 13) that sprinkler-system layout and installation be entrusted to none but fully experienced and responsible parties. Fig. 2-6 show a few approved piping hookups.

Standard systems are two types—wet-pipe, in which the entire system right up to the sprinkler heads is filled with water at all times, and dry-pipe, in which piping in building is filled with compressed air as far back as a special differential check valve. This valve releases water into the system the instant air pressure drops from opening of the first sprinkler head.

Wet-pipe systems are used in buildings that are always maintained above freezing temperature, dry-pipe type in buildings or sections of buildings that are subject to freezing temperature. Check valve must be protected against freezing. Sometimes a wet-pipe system filled with special anti-freeze solution is permitted by inspection authorities in small sections of buildings where low temperatures can occur.

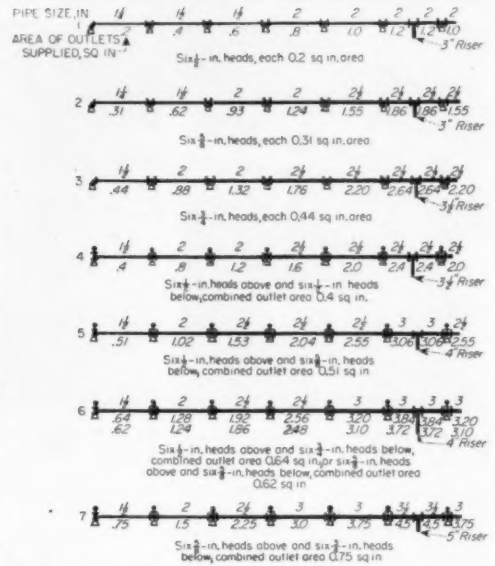
Special-Hazard Systems. Several types of automatic fire-protection systems are also available for special hazards. Some utilize dispersed water in both high-velocity and low-velocity spray forms for fires in oils, flammable liquids, paints and many other special-hazard materials. These special systems usually supplement a standard automatic sprinkler system and require similar provisions for access to water supplies. Early plan-

LOCATIONS FOR SPRINKLER RISERS



5 **LOCATIONS** used for sprinkler risers. Properly protect all risers from mechanical injury or possible freezing

HANDY CHART FOR SIZING BRANCHES


PIPE SIZE, IN
AREA OF OUTLETS SUPPLIED, SQ IN
Six ½-in. heads, each 0.2 sq in. area
3" Riser
Six ⅝-in. heads, each 0.31 sq in. area
3" Riser
Six ¾-in. heads, each 0.44 sq in. area
3½ Riser
Six ½-in. heads above and six ¾-in. heads below, combined outlet area 0.4 sq in.
3½ Riser
Six ½-in. heads above and six ⅝-in. heads below, combined outlet area 0.51 sq in
4" Riser
Six ½-in. heads above and six ¾-in. heads below, combined outlet area 0.64 sq in. or six ⅝-in. heads above and six ¾-in. heads below, combined outlet area 0.62 sq in
4" Riser
Six ⅝-in. heads above and six ¾-in. heads below, combined outlet area 0.75 sq in
5" Riser

6 **PIPE SIZES** for window sprinklers. With four 5/32-in. orifice heads use 2-in. pipe, No. 2. See standard for areas

ning is also a help and specialized engineering and experience is needed for design and installation.

A recent development in special-hazard types is the exhaust water-spray system for protection of life in buildings with open wells for stairs, moving stairways, and elevators. Joint development by Otis Elevator Co, Westinghouse Electric Corp and Grinnell Co, Inc, produced this system. It prevents open wells from carrying deadly gases and superheated air, from a fire starting on one floor, to floors above. Forced-draft ventilation counteracts flue action. It is applied to the area where the fire starts, cooling heated gases by water spray while the sprinklers extinguish or control fire.

Occupancy Types. Partial list of occupancies as specified by the NBFU is:

(a) Light-hazard. This class includes apartment houses, asylums, club houses, colleges, hospitals, hotels and office buildings.

(b) Ordinary-hazard. This includes mercantile establishments, warehouses, manufacturing and occupancies not covered by paragraphs (a) and (c).

(c) Extra-hazard. The class including only those buildings or portions of buildings where the hazard is severe as determined by the inspection department having jurisdiction.

Protection area allotted per sprinkler head varies from 196 sq ft for light-hazard occupancy and fire-resistive construction to 70 sq ft for extra-hazard occupancy and open joist construction. For economy in planning you must consider hazard rating of intended occupancy and type of construction. For instance, a long room of odd dimensions may need an extra line of supply piping. On the other hand, if large-area rooms are planned with dimensions that are multiples of 10, 12, or 14 ft, according to occupancy and construction, appreciable savings can be made when the sprinkler contractor is called in. Included in these savings is the cost of additional piping hangers, fittings and sprinkler heads. Major item of expense is installation labor. Proper preliminary engineering by competent men tends to reduce this cost.

Water Supply. To assure a satisfactory supply of water the following standards should be applied: "Every automatic sprinkler system shall have at least one automatic water supply of adequate pressure, capacity and reliability . . ." "A connection from a reliable waterworks system of adequate pressure and capacity is preferable as a single or primary supply."

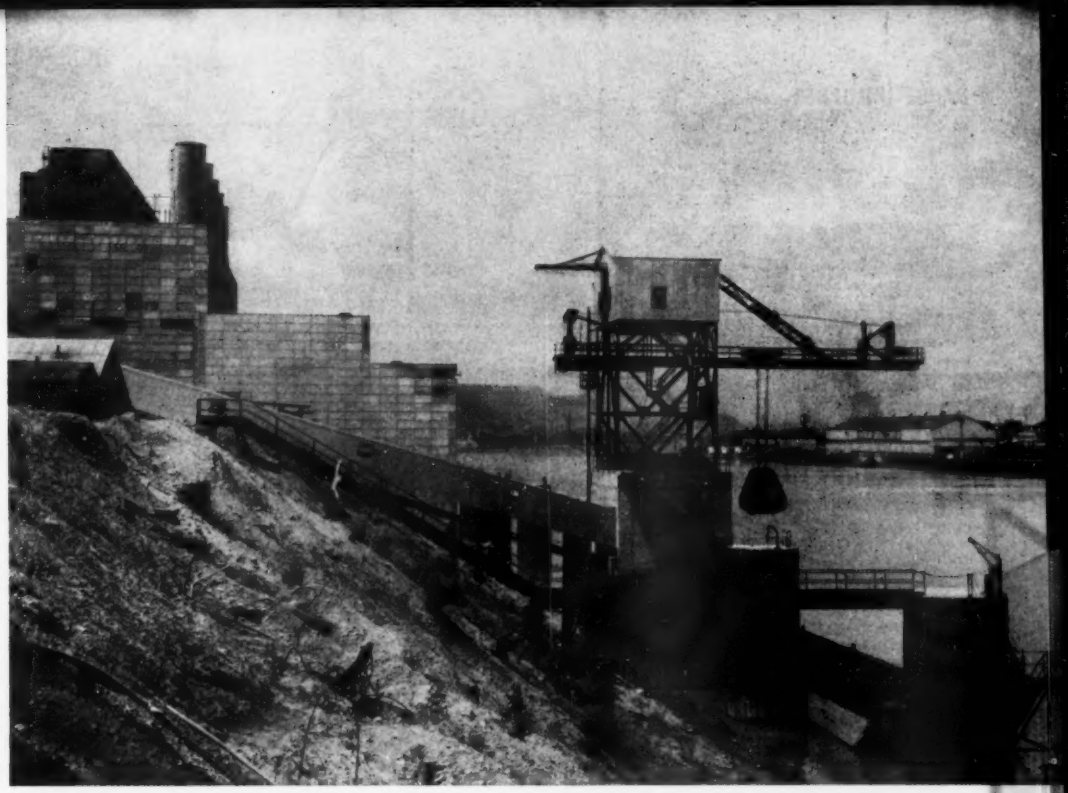
As alternatives under certain conditions, pumps, gravity tanks or pressure tanks may be used. A connection through which the public fire department can pump water into the sprinkler system makes a most desirable auxiliary supply. Flow tests from an outside hydrant, delivering 250 gpm for light-hazard occupancy and 500 gpm for ordinary hazard, should provide a residual pressure of not less than 15 psi at sprinklers under the roof.

Operating Temperatures. Sprinklers must always be approved makes and types. All designers should have a copy of *List of Inspected Fire-Protection Equipment and Materials*, Underwriters' Laboratories Inc, and *Approved Equipment for Industrial Fire Protection*, published by Associated Factory Mutual Fire Insurance Companies.

Within the approved makes and types of sprinklers there are variations of major importance because they affect actuation of the device. Since sprinklers are most effective when they operate as soon as a fire starts, the releases are the key to successful firefighting.

Heat-responsive releases on sprinklers are of two general types—solder and non-solder. In the ordinary temperature ratings, solder-type sprinklers are triggered to release when their temperature reaches 160 to 165 F. Corresponding non-solder types release at 135 to 150 F. With a slow-starting, smoldering fire, the earlier release of a quartzoid sprinkler, a non-solder type, is advan-

(*Continued on page 204*)



BARGES PLAY a large part in the coal-supply picture of many power plants. Keeping these barges moving and handling the unloaded coal efficiently requires well-laid-out dock facilities, good operation, but the investment gives excellent returns

HANGING A MOVING COUNTERWEIGHT ON A CLAMSHELL BUCKET DROPS HORSEPOWER NEEDS, SPEEDS OPERATION, SO...

Barge Unloader Lowers Handling Costs

By **E M HAYS**
Engineer, Dravo Corp

► RIVER BARGES HAUL a large share of the coal burned in the power plants along inland waterways. The way these barges are unloaded and the coal handled has an important bearing on the operating economy of these inland power plants. For this reason the Duquesne Light Co had Dravo Corp put in a highly efficient coal-handling system at the new Philips Station on the Ohio River at Wireton, Pa. This system is aimed at low-cost performance with simplified operation.

To achieve this aim the dock layout, photo above, unloading facilities and the unloader itself, Fig. 1, p 84, have been specially designed. The layout consists of ten mooring piers, 15 ft 3 in. dia, two ice breakers, 34 ft 9 in. dia, a spur dike from ice breakers into the bank, and a center unloading pier. Number and arrangement of mooring piers allows a flexibility in handling and docking of a number of barges. Ice breakers and auxiliaries extend this ease of handling into the winter months. These mooring piers and ice breakers feature steel sheet piling, driven to rock, sand and gravel filled, and capped with a concrete slab.

The barge unloading facilities consist of a coal tower with barge-moving winches, unloader, and hopper constructed on a 38-ft 3-in.-dia pier. A total of twelve 14 WF 87-lb H-beam piles support the corners of the tower structure. On top of the pier a 40-ton receiving hopper, within reinforced concrete, stands below the coal tower.

Inside this concrete structure on top of the unloading pier are the barge-moving winches. There are two 10-hp single-drum winches for this service. They handle one barge haul rope at a time. With one end of the haul rope attached to one of the winches the rope runs 162 ft upstream, loops around and returns at water level 185 ft downstream beyond the unloading pier and then along the top of the deck to the second winch. A ring at the center of the rope is placed over the barge bitt and held in place by a clamp. The two winches operate in parallel to move the barge

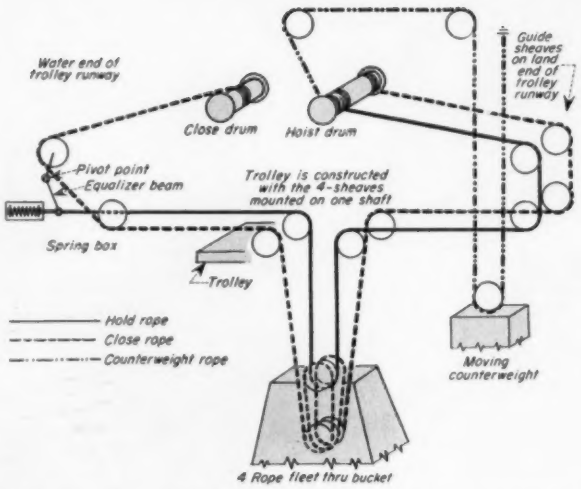
BARGE UNLOADER Continued

past the unloader. One winch pulls the barge while the other exerts a small counter torque pull in the opposite direction to the barge travel. This counter pull tends to retard barge movement and keeps the haul rope taut so the barge can't drift.

Electric, full-magnetic controllers with master switches operate the barge winches. Rope is ¾-in. steel cable under a normal rope pull of 9000 lb at a barge speed of 26 ft per minute.

The coal unloader employs a method for handling the clamshell bucket so different we give details below.

Once the coal gets to the 40-ton receiving bucket it drops onto a 54-in. belt feeder having two speeds—25 and 50 fpm. This feeder then delivers the coal to a 48-in. belt, 270 ft long, at a rate of 300 tons per hr for a 25-fpm speed, or 600 tons for 50. This belt moves at a speed of 300 fpm to carry the coal into the crusher building. From the building, coal can travel by belts to a yard stacker for storage, or go direct through crusher and into powerhouse.



1 Rope reeving attaches both holding and closing ropes to same drum for hoisting and lowering. With a counterweight on the bucket, operation is smooth, positive

HERE ARE THE WORKING AND DESIGN FEATURES OF THIS...

Handling the coal unloader's clamshell bucket in a special way promises to produce lower costs per ton for unloading barges at this particular plant. The unloader, Fig. 1, operates on ac and uses a rope-reeving arrangement to eliminate clutches and brakes on hoisting drums. Result is a simplified operation with little spillage.

Further, the load on the ropes hoisting the clamshell bucket is equalized at all times. This gives longer rope life, more economical operation and greater freedom to the operator since he no longer needs to judge the time intervals required to equalize the load on the ropes hoisting the bucket.

The unloader, Fig 2, of all-welded design, consists of a tower, horizontal cantilever boom carrying the rope-operated trolley, a clamshell bucket, moving bucket counterweight and power machinery.

The bucket trolley travels out on the boom over a maximum distance of 46 ft 4 in. from the center line of the receiving hopper. Actually, this includes an over-travel beyond the barge cargo hopper. This means the bucket can be spotted better at the side of the barge hopper both for digging and for coal cleanup.

The coal bucket, a 4-rope fleet-through geared hinge, corner bar design, weighs about 15,000 lb, and has a normal capacity of 260 cu ft or 6½ tons of coal weighing 50 lb per cu ft. Bucket arrangement permits reeving a ⅞-in.-dia closing cable, six parts in the bight of the line. All bucket sheaves, 27⅜-in. pitch dia, mount on antifriction bearings. Both holding and closing ropes attach to the same drum to hoist and lower the bucket. (This feature differs from conventional ac-operated unloaders.) A separate closing hoist operates only to close and open the bucket.

Rope Reeving. Fig. 1 shows the hold-and-close line rope-reeving of this particular bucket. The holding cable clamps to the hoisting drum, leads over the sheaves at the land end of the trolley runway, then over a sheave in the trolley. It continues down to a sheave in the top of the bucket, back up over a second sheave in the trolley and dead-ends at the water end of the trolley runway on an equalizer beam.

The closing cable also attaches to the hoisting drum and is reeved in the same way as the holding cable up to the bucket. But at the bucket this cable reeves around sheaves in the bucket top and other sheaves attached to the bucket scoop arms. The cable then leads back up over another sheave in the trolley to the water end of the trolley runway. Here it passes over a sheave fastened to the equalizer beam and back to a separate closing drum in the machinery house where it is anchored.

Equalizing Loads. The equalizer beam, Fig. 1, attaches to the boom at the pivot point of the equalizer. The holding cable anchors at the top of this beam. Fixed stops, spring-cushioned, allow the equalizer unit only a very limited movement. When the bucket is hoisted the equalizer stands free of the stops so the load on both holding and closing cables equalizes.

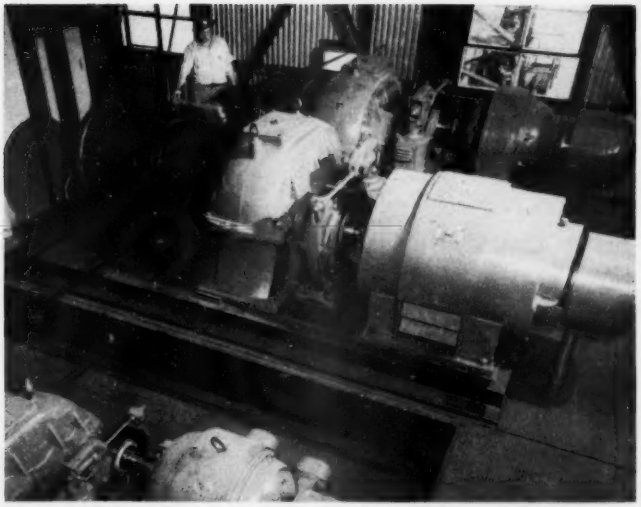
Opening and Closing. All the closing drum does is open and close the bucket. It has no part in hoisting or lowering the bucket. When the bucket is to open, 37 ft, 3 in. of closing cable is paid out so the scoops can spread. This same length of cable is taken up to close the bucket.

A traveling-nut-type limit switch, geared to the closing drum, operates when the correct amount of closing cable pays out or is taken up. It automatically stops the close-drum drive motor and sets the electric brake on this drive.

Lowering and Hoisting. The hoist drum serves only to lower and hoist the bucket. Because of this single job a third cable can be attached to the drum and led over sheaves to a traveling weight that moves opposite to the direction of bucket travel.

This means that when the bucket is

2 Trolley over-travel beyond barge hopper permits better cleaning out



3 Unloader has three drum drives: middle one is a hoist drum for lowering and hoisting; top is bucket-closing one, while the bottom is trolley racking drive

...FAST-MOVING, AUTOMATIC-BUCKET-CLOSING BARGE UNLOADER

being hoisted by the drum drive the counterweight is being lowered. When the bucket is lowered the counterweight is raised. The counterweight equals the total weight of the bucket, 15,000 lb, plus one-third material full load, about 4500 lbs.

The hoisting-drum drive motor is always lifting a load. And because of this, good speed control can be exercised over hoisting the loaded bucket and lowering the empty one. For example, when hoisting a fully loaded bucket the actual load on the motor amounts to two-thirds of the material load in the bucket. When lowering the empty bucket the motor handles a hoisting load equal to a third of the material load because it is raising the counterweight. Result is a positive hoisting load instead of an overhauling load as where counterweights are not used.

A simple reversing electrical magnetic controller operating with the wound-rotor motor secondary resistors provides smooth slow-down speed for landing the bucket and paying out the necessary slack cable with the bucket resting on the coal pile.

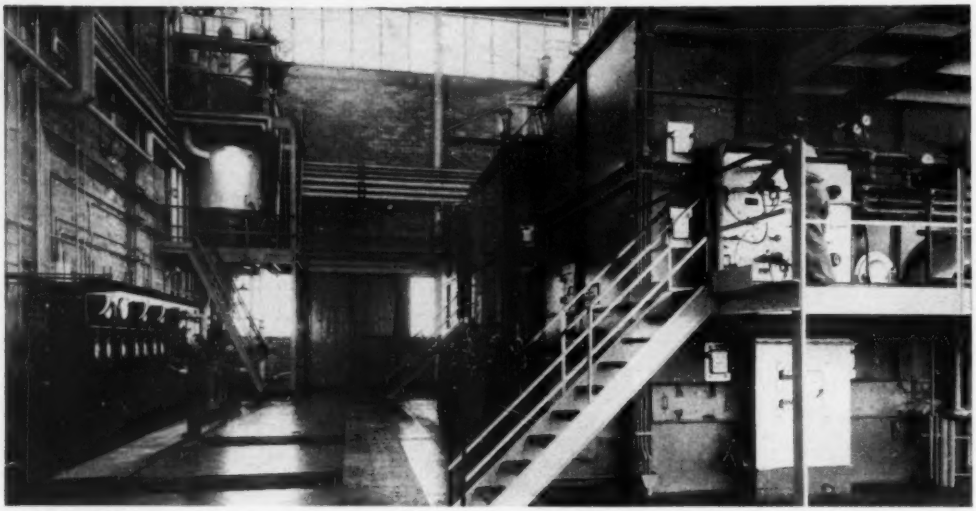
The maximum torque the drive motor can produce determines the ratio of counterweight to full-loaded bucket weight. Further, the motor torque must be capable of hoisting the moving counterweight without any overhauling pull. In this way the hoisting cable can have enough slack to let the empty bucket go down into the coal pile during its closing. Even with this requirement the horsepower saving on the hoisting drum drive is appreciable.

Unloader Operation. With the bucket resting on the coal pile in the barge, about 85 ft below the trolley runway, the operator flips the closing-drive master switch over to the close position. The closing drive operates and takes up enough cable to close the bucket. At this point the limit switch on the drive cuts off the motor power and sets the brake instantly. The operator need not touch the close master switch. This switch can stay in the operating position without effecting any further take-up of cable. The cut off is completely automatic. Next, the operator moves the hoisting-drive master switch to the up position to energize the drum motor. If the bucket has not fully closed, because of slack cable previously paid out, closing is automatically completed by pull from the hoisting drum on the closing rope while the drum is simultaneously taking up the holding-line slack. This assures a fully closed bucket before the hoist begins.

As soon as the bucket closes the load is equally distributed on all cables and the bucket hoisted. Stop of the bucket hoist for normal operating cycle is left up to the operator. But, if he fails to stop the bucket hoist, a limit switch on the hoisting drum cuts off the motor drive and sets the brake at the extreme hoist position. To open the bucket the operator again flips the close-drive master-switch to the open position. Automatically the drive pays out the correct amount of cable to open the bucket and the limit switch stops it.

Trolley operation for moving the bucket in and out is also controlled by a master switch. Limit switch protection at each end of the trolley runway stops the trolley racking in emergency cases should the operator fail to return his master switch to the off position.

This unloader can make a round trip in 33 sec—that is, dig a full bucket of coal from the barge, transport it to a point over the hopper and return it empty to the barge. Bucket hoisting speed is 520 fpm; bucket-closing rope speed 620 fpm; and trolley racking speed 440 fpm. Operating continuously on this cycle time, a free digging rate of 700 net tons per hr can be delivered, but only provided the piles are of sufficient depth to insure rated load pickup by the bucket each trip. No time is allowed for cleaning up a barge in this rate. With all things considered, including the barge mover and an efficient operator, this unloader can handle 500 net tons per hour.



BOILER PLANT. Three 20,000-lb-per-hr boilers installed, with space for a fourth. They are oil fired from the side by two steam-atomizing burners. Two units have chain-grate stokers also, for firing with coal if this becomes necessary in an emergency

Meters Guide Steam Plant and

For high reliability and efficiency, plant design places boilers and electric substation under one engineer. Automatic-controlled boilers are metered for practical test performance at all times. Power circuits are metered to show their load and other data

By **FRANK A HINCHCLIFFE,** *Powerhouse Chief Engr, Northern Electric Co, Ltd*

► At Lachine, Quebec, a suburb of Montreal, the Wire and Cable Division of the Northern Electric Co built a new plant. It supplies about 50% of the Division's production of all types of wire and cable for industrial and construction purposes. At present the remainder of the Division's manufacturing is done at the Shearer St plant, Montreal. Eventually all wire and cable manufacturing will be moved to Lachine, thus doubling this plant's production capacity.

Plant Load. Production of wire and cable requires (1) ac power for annealing furnaces and motor operation (2) dc power for adjustable-speed control of wire-drawing-machine motors (3) steam for cable drying, vulcanizing, heating plastics, wire drawing, pickling solutions (4) compressed air for operation of air brakes, clutches, ejectors, hoists and turntables (5) cooling water (6) gas for heating tinning baths (7) light oil for heating lead kettles.

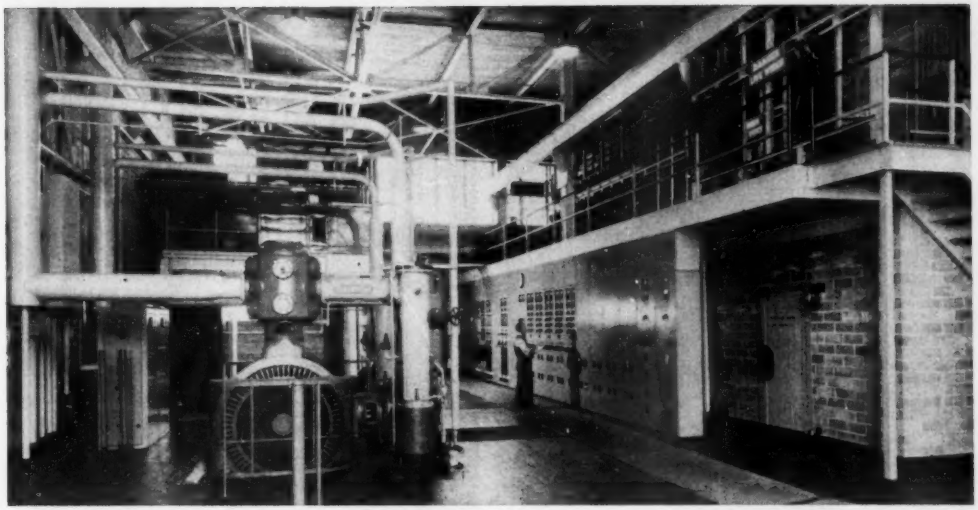
Montreal is one of the few large cities of the world favored with several million hydro horsepower almost on her doorstep. This insures an ample supply of low-cost power for many years. Because of this the engineers who designed the plant decided in favor of purchasing all power and generating steam only.

Plant Design. To put all steam, power-distribution equipment and air compressors under supervision of a single engineer, the powerhouse was designed as a combination boilerhouse and substation. Size of this building, 128 ft long, 82 ft wide, 51 ft high, is ample for future steam and power needs. It houses boilers, air compressors, fire pumps, power substation and main switchboard. Placing all power and steam operations under a single engineer eliminates divided responsibility, reduces possibilites of operating mistakes and increases reliability.

Steam Load. Steam is required for building heating and for process. Because of low winter temperatures, steam load is heavy during this period and comparatively light in summer when heating is chiefly process. Studies of space heating and process needs indicated that 40,000-lb-per-hr maximum load could be expected, reaching 60,000 lb per hr with completion of the expansion program.

Since 75% of the steam load is space heating, three 20,000-lb-per-hr boilers were installed, with space for a fourth unit. This gives 50% standby capacity during peak demands in winter and permits reducing plant capacity comparable to light summer load. The arrangement not only insures high reliability at all times but permits operating at good thermal efficiency under summer loads.

Boiler Installation. Steel-incased, water-tube boilers are integral-furnace type. Designed for 160 psi saturated,



POWER SUBSTATION. All power equipment outside the boiler room is installed here. Two 750-cfm motor-driven air compressors are in left foreground. Power transformer and high-voltage switches are in a room in back of the switchboard

Substation Operations

they operate at 120 psi. Each boiler has a continuous rating of 20,000 lb per hr, and 25,000 lb per hr for two hours. Two steam-atomizing burners fire each boiler.

Fuel Supply. Past experience shows that a fuel supply can be uncertain in quantity, quality and price. These factors were given careful study in the plant design. Even though oil is the most economical fuel at present, and looks as if it may be for a long time, provisions were made for a quick change to coal.

Boiler settings have ashpits and ductwork for stoker firing. Two boilers have chain-grate stokers, with grates bricked over for oil firing. A basement tunnel, 10x10 ft in cross section by 82 ft long, at the rear of the boilers, will house ash-conveying equipment should it be necessary to go to coal firing.

Oil-Storage Tanks. Fuel oil is stored in three tanks with a total capacity of 135,000 gal. One of these tanks above ground has 85,000-gal capacity for standby. Two underground for service have each 25,000-gal capacity. Oil in the service tanks is maintained at constant temperature by thermostats that control valves in steam lines.

A 15,000-gal underground tank stores light oil for heating lead kettles. Pumps for handling this oil are in the boiler room where they are under supervision of the operating engineers. Piping to the oil burners is arranged so, when steam is not available, light oil and compressed air can be used to start up the boiler, using the same sprayer plates as with heavy oil.

Combustion Control and Meters. Fuel and air to the burners are automatically controlled in response to small variations in steam pressure. Coal-to-oil transfer valves permit automatic control of stokers if required. Compressed air operates relays and power drives of the combustion-control system.

On the combustion control panel a master-controller recorder gives a graphic record of main steam-header pressure, feedwater pressure and temperature. Boiler meters record and integrate steam flow, and record air flow and flue-gas exit temperature on each boiler. A water-level recorder on each boiler has low and high-water indicating lamps and alarms.

To hold air pollution from the plant at a minimum, each boiler has an electronic smoke-density indicator on the control panel, in easy sight of the operator. Also on the control panel are multipoint draft gages, steam-pressure gages and boiler feedwater chemical-pump timers, as well as push-button stations for forced and induced-draft fans, stokers and chemical-pump motors. Hot-oil meters in the oil line to each burner permit making efficiency checks for any load condition at any time. With the automatic controls and meters the watch engineers can operate the boilers under practical test conditions.

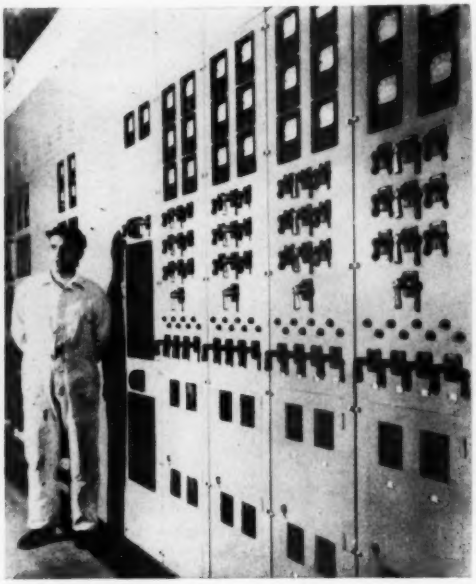
Other Gages and Meters. On a separate panel adjacent to the fuel-oil pumping and heating equipment are liquid-level meters for the oil-storage tanks; also, gages that show steam pressure to fuel pumps and oil preheaters, preheater oil-outlet pressure, suction-strainer inlet and outlet vacuum, discharge strainer, and inlet and outlet pressure, light-oil suction and discharge pressure.

Temperatures are indicated for oil-storage tanks, heavy-fuel-oil pump suction and preheater discharge. Thermometers in wells on each oil line check the panel instruments. A water meter in the makeup line to the deaerating heater is valved so flow can be metered and fed to the hotwell when the deaerator is open for inspection.

Hotwell has sight glasses and an altimeter to show its contents. An indicating light, alarm and pressure gage give warning if city-water pressure gets too low to discharge in the deaerating heater.

Draft Equipment. A short stack, a forced- and an induced-draft fan provide draft for each boiler. Ac squirrel-cage motors drive the fans at constant speed. Control of forced-draft dampers

MERCURY-ARC RECTIFIER has eight glass bulbs, each with three anodes. It is air cooled from a fan below the bulbs



MAIN SWITCHBOARD. Section of the main switchboard where the meters are located for the 24 power-distribution circuits

is by steam pressure, and induced-draft units by furnace pressure.

During winter months combustion air comes through two fresh-air intakes at the 45-ft level in the boiler-room wall. Here it passes over steam-heated coils fitted with a modulating bypass damper controlled by a thermostat set to deliver air at 70 F. Two intake-air heaters each with 8000-cfm capacity, from -10 to 70 F, are installed. Unit heaters with thermostat control, mounted along outside walls, make up any heat needed for comfort in boiler and power substation.

Forced-draft fans, at floor level in the boiler room, tend to exhaust air from the room when all windows are closed, as in winter. As a result fresh air is induced to pass over the steam coils and is heated as it comes into the room. A combustion safeguard protects each furnace against explosions that might result from flame failure.

Space heating in the plant is by 75 unit heaters, of which 72 operate on boiler pressure. Condensate from these discharges to a flash tank from where flash steam goes to three low-pressure heaters. Flash steam is also used to heat water for the office-heating system and the domestic hot-water supply. The flash tank discharges to a receiver vented to atmosphere and the condensate is pumped to the boiler-room hotwell. During summer when unit heaters are not in use, a reducing valve on the live-steam line supplies 6-psi steam.

Air Compressors. Two 750-cfm air compressors, direct driven by 150-hp synchronous motors, supply air at 100 psi for manufacturing operations. Air for combustion-control equipment is also supplied from these compressors through a pressure-reducing valve to a separate receiver.

A check valve between this receiver and the 100-psi line permits a 50-cfm compressor to discharge to the small receiver when the large machines are shut down. Operation of the small compressor is automatic through a pressure switch. The small compressor starts when the pressure of the main supply drops below 75 psi.

Air is supplied to the plant at 100 and 15 psi. An air-flow meter indicates, records and integrates air flow to the plant. Readings of this meter and of the watthour meter on the compressor motors give a check on compressor performance.

Power Supply. All power is purchased from the Quebec Hydro-Electric Commission, supplied at 12.3 kv over two underground lines from their Rockfield substation ½ mile away. One line is for normal use, the other for emergency. Each circuit connects to an oil circuit breaker in the high-tension switch room of the powerhouse. All high-tension switchgear is ironclad type and the incoming-line breakers are electrically interlocked for automatic changeover. A preselector switch holds the normal or preferred line in service when power is available on that line. If power fails on the preferred line, the load is switched automatically to the emergency line. As soon as normal voltage comes on, the preferred-line load is automatically switched to it.

Mercury-Arc Rectifier. A 275-kw glass-bulb fan-cooled mercury-arc rectifier is supplied from a 500-kva 12.3-kv 12-phase transformer. This rectifier has eight bulbs, each with three anodes. Four of the bulbs are in the main-output 250-kw side of the rectifier and four bulbs are in the 70-kw balance circuit. The units supply 230-v dc power for adjustable-speed motors on wire-drawing and other machines.

Main switchboard is one of the interesting features of the plant. In addition to the usual indicating lights, and relays for remote control, each circuit is well metered. On the panels are mounted the Hydro-Quebec meters for load and maximum demand. On the 12.3-kv supply, volts, amperes, kilowatts and power factor can be read on indicating meters. Volts, kilowatts and power factors are also recorded.

The plant's 440-v load is distributed on 20 circuits going to different departments. Each circuit has a watthour and a maximum-demand meter. In addition, by a system of rotary switches,

PRINCIPAL POWER-PLANT EQUIPMENT

Northern Electric Co, Wire and Cable Division, Lachine, Quebec

STEAM GENERATION:

Boilers, waterwalls.....Babcock-Wilcox & Goldie-McCulloch, Ltd
Boilers, three, 2-drum, integral furnace; heating surface, 4207 sq ft; waterwalls, 800 sq ft; max continuous steaming capacity, 20,000 lb per hr; max 2-hr rating 25,000 lb per hr; design steaming conditions 160 psi, saturated; operating pressure, 120 psi. Furnace 1180 cu ft; Btu release per cu ft per hr, oil 22,000, coal 25,000 at 20,000 lb of steam per hr; at max 2-hr rating 25,000 lb of steam per hr, oil 27,600, coal 31,000.
Boiler refractories and heat insulation.....Babcock-Wilcox & Goldie-McCulloch, Ltd
Stacks and boiler breechings.....Prat-Daniel Corp
Self-supporting, three, 30 ft high, 3 ft 6 in. inside diameter at top

COMBUSTION EQUIPMENT:

Automatic combustion controls.....Bailey Meter Co
Soot blowers, 3,.....Diamond Specialties, Ltd
Stokers, 2, chain grate.....Babcock-Wilcox & Goldie-McCulloch, Ltd
Grate area, 93.5 sq ft
Stoker drive, variable speed.....Reeves Pulley Co
Oil burners.....Babcock-Wilcox & Goldie-McCulloch, Ltd
Two per boiler, steam atomizing
Fuel-oil heaters 2.....Darling Brothers, Ltd
Fuel-oil pump, 1, direct-acting, 18 gpm.....Darling Brothers, Ltd
Fuel-oil pump, 1, motor-driven, 18 gpm.....DeLaval Steam Turbine Co
Oil steam-pump governor.....Fisher Governor Co
Oil, constant-pressure relief valve.....Darling Brothers, Ltd
Relief valves.....Darling Brothers, Ltd
Suction and discharge oil strainers.....Darling Brothers, Ltd
Oil-temperature regulators.....Powers Regulator Co, Ltd
Fuel-oil storage tank.....Toronto Iron Works
One, above ground, 85,000 gal
Fuel-oil storage tanks.....Farand & Delorme
Two, underground, steam-heated, 25,000 gal
Light-oil storage tank.....Farand & Delorme
One, underground, 15,000 gal
Oil transfer pump, 1, motor-driven, 90 gpm.....Viking Pump Co
Light-oil pump, 2, motor-driven, 3.8 gpm.....Schutte & Koerting Co
Forced-draft fans, 3.....Canadian Blower & Forge Co
Motor driven, 9720 cfm at 3.75 wg and 105 F
Forced-draft fan motors.....Lincoln Electric Co of Canada, Ltd
Squirrel-cage, across-the-line start, 10 hp, 440 v, 1750 rpm
Forced-draft fan motor starters.....Cutler-Hammer, Inc
Induced-draft fans, 3, Thermix.....Prat-Daniel Corp
Motor driven, 17,400 cfm, 1.2 wg, 555 F
Induced-draft fan motors.....Wagner Electric Corp
Squirrel cage, across-the-line start, 7½ hp, 440v, 1750 rpm
Induced-draft fan motor starters.....Cutler-Hammer, Inc
Intake-air heaters, Two, 8000 cfm.....L J Wing Mfg Co
Unit heater in boiler room.....L J Wing Mfg Co

PUMPS AND COMPRESSORS:

Fire pumps, 2,.....Canadian Fairbanks-Morse Co
One gasoline-engine and one motor-driven, 1000 gpm, 125 psi
Fire-pump gasoline engine.....Continental Motors Corp
Fire-pump motor.....Canadian Fairbanks-Morse Co
Fire-pump-motor starter.....Cutler-Hammer, Inc
Condensate pumps, motor-driven.....Darling Brothers, Ltd
Two, 150 gpm, 90-ft head, two 75 gpm, 80-ft head
Condensate-pump motors.....Tampec Electric Co
Condensate-pump motor starters.....Cutler-Hammer, Inc
Emergency water-supply pump.....Darling Brothers, Ltd
One, motor-driven, 200 gpm, 90-ft head
Air compressors.....Canadian Ingersoll-Rand Co, Ltd
Two, motor-driven, 750 cfs, 90 psi
Air-compressor motors.....Canadian General Electric Co, Ltd
Synchronous, 150 hp, 440 v, 360 rpm
Air receivers, 2, and after cooler.....Canadian Ingersoll-Rand Co Ltd
Combustion-control air compressor.....Reavell & Co, Ltd
One, vertical, single-acting, motor-driven, 50 cfm, 50 psi

VALVES AND PIPING:

Safety valves.....Consolidated Safety Valve Co
Non-return valves.....Crane, Ltd
Blowoff valves.....Yarnall-Waring Co
Gate valves.....Crane, Ltd
Globe valves.....Jenkins Bros, Ltd
Oil-lines valves.....Jenkins Bros, Ltd
Pressure-reducing valves.....A W Cash Co
Feedwater valves.....Crane, Ltd
Piping contractor.....Connolly & Twizzell
Pipe-heat insulation.....Asbestos Covering Co
Traps and strainers.....Armstrong Machine Works

FEEDWATER SYSTEM:

Feedwater chemists.....E F Drew & Co, Ltd
Feedwater chemical pumps, 3,.....Milton Roy Pump Co
Chemical-pump timers, 3.....Automatic Temperature Control Co
Feedwater heater.....Permutit Co
Deaerating, 80,000 lb per hr from 65 to 220 F
Feedwater storage tanks.....Farand & Delorme
Feedwater regulators.....Bailey Meter Co, Ltd
Water columns.....Reliance Gauge Column Co
Feedwater pumps.....G & J Weir, Ltd
Two direct-acting, steam: one 23,500 lb per hr, one 63,000 lb per hr, 200 psi
Feedwater-pump governor.....Fisher Governor Co
Feedwater pump.....Babcock-Wilcox & Goldie-McCulloch, Ltd
One, motor-driven, 60,000 lb per hr, 200 psi
Feedwater-pump motor.....Commonwealth Electric Corp, Ltd
Feedwater-pump motor starter.....Cutler-Hammer, Inc

METERS:

Boiler control panel, steam-flow air-flow, multipoint draft gages, temperature recorders and indicators, and flue-gas temperature recorders.....Bailey Meter Co, Ltd
Steam-pressure gages.....Ashcroft Gauge Co
Combustion-air and out outdoor-temp recorder.....C J Tagliabue Mfg Co
Feedwater-level recorder.....Bailey Meter Co, Ltd
Industrial thermometers.....Taylor Instrument Cos of Canada, Ltd
Oil-pressure gages.....Pitanco Instruments Co, Ltd
Smoke-density indicator and recorder.....Bailey Meter Co, Ltd
Flame-failure protection.....Brown Instrument Co
Hot-oil meters.....Neptune Meters, Ltd
Air-flow meter.....Bailey Meter Co, Ltd
Feedwater flowmeter.....Neptune Meters, Ltd

ELECTRICAL EQUIPMENT:

Power transformers.....Ferranti Electric, Ltd
Four, 1250 kva, 13,000 to 440 v; four, 333 kva, 13,000 to 220 v
Rectifier transformer, 500 kva.....Hackbridge & Hewittic Elec Co
Mercury-arc rectifier, 275 kw.....A Reyrolle Co, Ltd
Oil circuit breakers.....A Reyrolle Co, Ltd
Relays and automatic changeover.....A Reyrolle Co, Ltd
Indicating meters, 54.....Weston Electrical Instrument Corp
Watt-hour meters, 32.....Sangamo Electric Co
Recording kilowatt meters, kilovolt and power-factor meters.....A Reyrolle Co Ltd
Switchboard, 1.....Amalgamated Electric Co
Storage battery.....Exide Batteries of Canada, Ltd
Sixty cells, 125 v for emergency lighting and circuit-breaker operation
Air-break circuit breakers.....ITE Circuit Breaker Co

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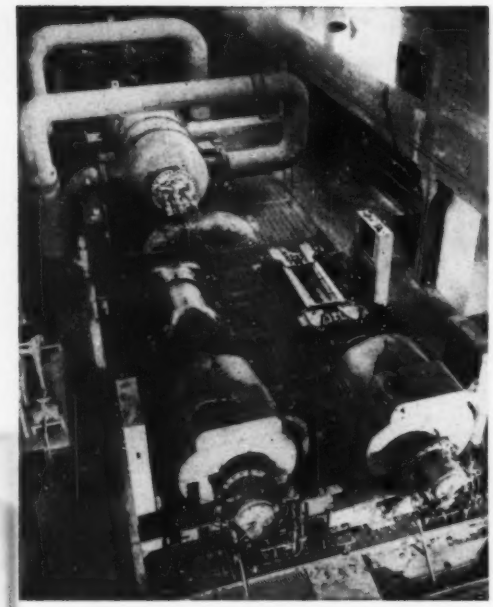
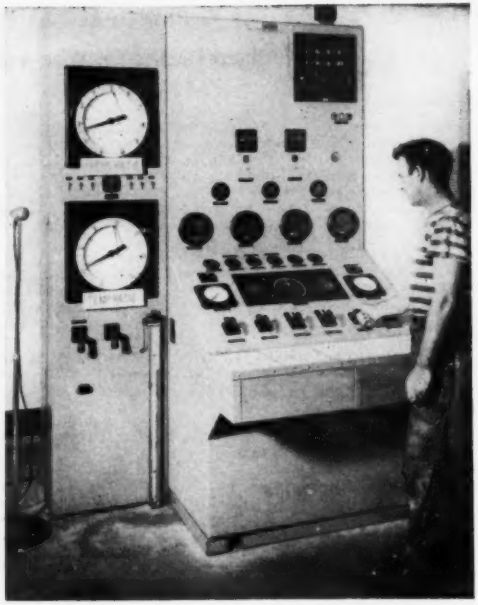
volts, kilowatts and power factor of each circuit can be read and the amperes in each phase indicated. This permits knowing the circuit conditions and power costs to each production area in the plant. All dc circuits are similarly metered. Electrical load is well balanced so that the average pf is 0.88, without using capacitors. Power-factor correction is obtained by three synchronous motors. Two drive air compressors in the powerhouse and the third is on motor-generator set in plant.

Mechanical design was done by McDougall and Friedman, consulting engineers, Montreal; electrical design was by Frank Fewtrell, Northern Electric Co, J J H Miller, plant superintendent, service division, Northern Electric Co. was responsible for overall planning during construction.



1 Low-stage, *left*, and high-stage axial-flow compressors standing in test way are driven by steam turbines, *front*



2 Temperature and pressure ratio recorders stand in control gallery overlooking axial-flow compressors in the test way

Unstable operation spells out disaster for axial-flow compressors. By knowing actual pressure and temperature ratios they avoid danger when . . .

...Guarded by Potentiometer Watchdogs

By **R N GRASSI,** *Aviation Turbine Division, Westinghouse Electric Corporation*
and W H WANNAMAKER, *Brown Instruments Division, Minneapolis-Honeywell Regulator Company*

► ONCE A JET ENGINE is assembled it's difficult to find the performance of any of its components. Hence, we must have a laboratory for testing individual components under simulated full-load operating conditions. This involves expensive machinery of considerable power and dissipation of large heat quantities.

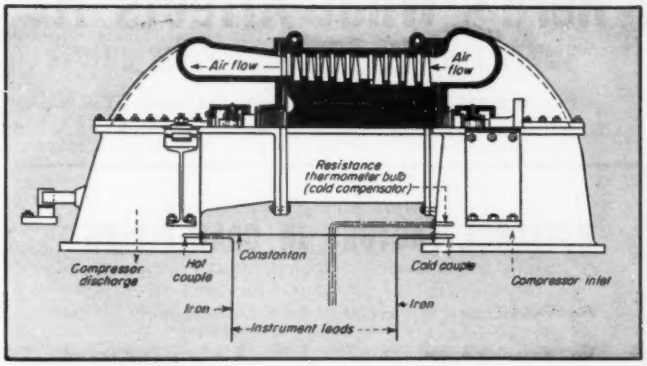
One of the major testing needs is a flexible air-compressor service capable of performing efficiently under widely varying pressures and flows. To meet this, Westinghouse Electric Corp designed and built two compact high-efficiency compressors of the axial-flow type. Fig. 1 shows them installed in a test way at the Aviation Gas Turbine Development Laboratory.

A 2800-hp steam turbine drives the low-stage compressor at 2:1 pressure ratio. The second or high-stage compressor develops 4:1 pressure ratio when driven by its 6600-hp steam turbine. The schematic diagram, Fig. 4, shows the system provides either pressure or evacuation service. The compressors either run individually or in series with intercooling. When in series, a total input of 9400 hp compresses about 58 lb per sec of air from the intake to 118 psia.

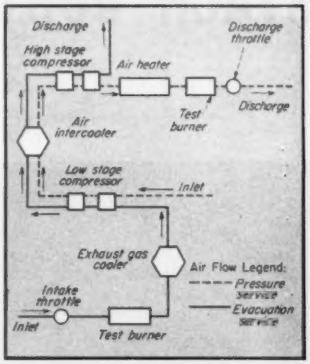
For high-power turbine tests the output air passes through metering and valving to a large combustor. This provides combustion products at pressures up to 8 atmospheres and temperatures up to 1800 F. Output air from one or both compressors can be directed to other equipment for combustion work. By valving the compressors for evacuation service, exhaust from combustors on test can be withdrawn forcibly for certain altitude checks.

Compressor Operation. Fast-changing test conditions and the unmatched characteristics of apparatus tested put a greatly varying load on the compressors. This raises the danger of unknowingly running one or both compressors in an unstable region of their operating characteristic. When in the range beyond the stall point, where pressure surges start, the equipment can be seriously damaged. The pressure surges vibrate both rotor and stationary

THERMOCOUPLES HOOKED UP IN OPPOSITION SEND MESSAGES ABOUT TEMPERATURE RATIO



3 Thermocouples in compressor inlet and discharge generate net emf to be measured by automatic potentiometer. Resistance thermometer is an automatic compensator



4 Laboratory compressors can be used to push the air in or pull gases out

blades of the compressor severely. Failure of only one blade in the forward rows of the compressor can wreck the equipment.

Approach to and operation in the unstable region cannot always be detected immediately. Hence we needed a precise indication of the relative point of compressor operation. Usually compressor efficiency drops when entering the unstable region. Knowing initial efficiency of a compressor, we can plot a family of curves showing efficiencies at various absolute pressure and temperature ratios as in Fig. 5. These show that for given pressure ratios the temperature ratio rises with decreasing efficiency. The temperature ratio alone, however, cannot be taken as showing inefficient operation. Fig. 6 shows that speed and load also play a part. When driving a compressor at constant speed, if the air flow decreases the pressure ratio increases.

Steady decrease in air flow eventually brings operation into the unstable region at lowering efficiency. Positive evaluation of pressure and temperature ratios, while a compressor is running, would show the efficiency which in turn would indicate approach to instability along a constant-speed curve.

In operation, the compressor first comes up to full speed with no load. Closing the load valves causes the temperature ratio to rise toward the stall point. Adjustments are made to prevent entering the unstable region. Ordinarily the temperature ratio must be low. A relatively high ratio indicates high load or over-load and when considered with other factors positively identifies safe and unsafe zones of operation.

Some means of accurately measuring and indicating temperature ratio continuously would make the operating zone identifiable. In combination with indications of the pressure ratio, we can find actual operating efficiency quickly. Knowing the latter we can also check the working condition of the compressor. Fouling or "coking" of the blades reduces efficiency and usefulness. Periodic efficiency checks will show when the compressor needs cleaning. Work schedules can then be arranged to conform with its scheduled down time.

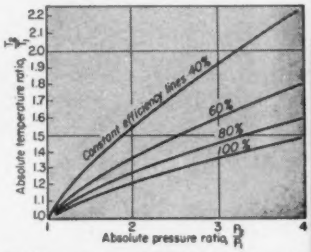
Measuring Temperature Ratio. Problem of continuously measuring and indicating the absolute temperature ratio was given to Brown Instruments Division engineers. They adapted a circuit modification of their standard recording potentiometer.

Fig. 3 shows location of iron-constantan thermocouples in compressor inlet and discharge lines. Extension wires of the same materials connect the thermocouples. Thermocouple electromotive forces oppose each other. Resultant emf between leads to the instrument is proportional to the difference between temperatures at inlet and discharge.

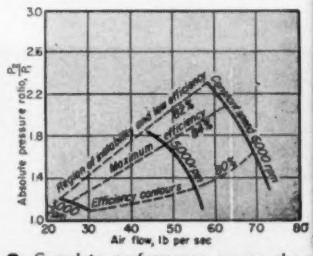
The measuring instrument is calibrated for a given compressor inlet temperature. To obtain automatic compensation for inlet temperature changes a resistance thermometer is incorporated into the circuit. The resistance thermometer mounts in the inlet line, as close to the cold thermocouple as possible.

The resistance thermometer connects into the bridge circuit of the instrument so it governs the current flow, Fig. 7. Connected in this way, current through

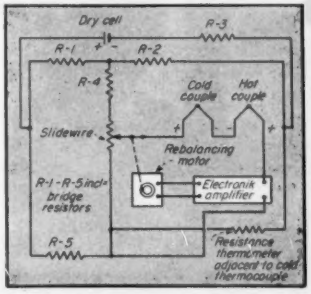
(*Continued on page* 202)



5 Compressor characteristic shown by temperature vs pressure ratio plot



6 Complete performance curves show unstable area for operating conditions



7 Simplified diagram shows circuit of automatic measuring potentiometer

STACK DUST: Here's What Affects It

By ELMER R KAISER *Asst Director of Research, Bituminous Coal Research*

STACK DUST is a mixture of nuisances

NUISANCE FACTORS IN COAL FIRING

Flyash—particles of noncombustible solids remaining in the flue gas after combustion

Cinder—hollow or porous particles of charred coal and coke formed in the combustion process

Flue Dust—combination of flyash and cinders

Dust-Size Consist—particles run from 10-1410 microns, which means from the sub-sieve range to 14 openings per inch U. S. Sieve Series

Smoke—particles under one micron (1/25,400 in.) resulting from incomplete combustion of volatile matter

Soot—agglomerated smoke particles

Ash—originally finely divided throughout the coal structure. During combustion process some becomes loose and powdery; some forms coherent layers; some sinters to form either agglomerates or clinkers, too heavy to float in rising gas

COMPLETE COMBUSTION reduces smoke

FURNACE HEAT AND ASH FORMATION

Pulverizer and Spreader Firing. Small particles in suspension soften and swell under heat (up to 40 times in a furnace atmosphere of 1100 F) to an average of 11 times the original volume. In this form they are called cenospheres

Density of particles decreases with swelling—from a starting 1.3 to 1.7 down to 0.12 to 0.15, on the average, to 0.033 in extreme cases.

Cenospheres form before most of volatile matter has been released. Unless there is enough time to burn off this gas and penetrate cenosphere windows, the particle leaves the furnace with the gas stream

Underfeed Stoker. Small pieces of coal combine to form large pieces of coke. Ash fuses into clinkers under high fuel-bed temperature

Traveling Grate. Tempering fuel with moisture helps retain fine particles on fuel bed so heat affects them at fuel-bed level. Some ash sinters in the fuel bed but large clinkers do not form

Cyclone Burner. Incoming coal held on a layer of slag by centrifugal force of a vortex of air and combustion gas. Ash consolidates in molten coal; 84% leaves in molten form under continuous tap

FIRING METHODS AND DUST INFLUENCE

Pulverized Coal. With fuel pulverized to 70% minus 200 mesh, 93% minus 100 mesh, all of it is in the size range of dust. On burning in suspension all particles are easily carried in the gas. Combustion is quite complete, but less than half of the ash in the coal remains behind. (And this only when agglomeration of fused particles or adhesion to furnace walls, tubes, bottom takes place.) Dust contains only 1-2% of fuel value of coal

Spreader Stoker. Incoming fuel size ranges up to 1¼ in. Smaller particles up to ⅛ in., depending on operating rate, burn in suspension. Larger pieces land on the grate to make up a thin fuel bed. About one third of the ash leaves the furnace

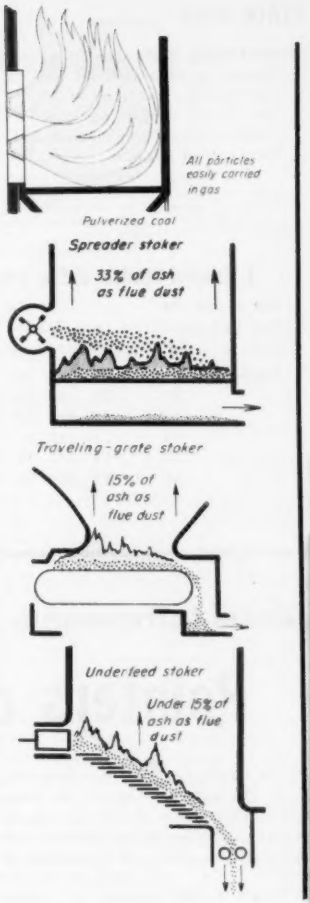
Traveling Grate. Fuel enters on the grate, may be tempered with moisture. Only about 15% of the ash in the coal is carried out of the furnace by the gas

Some authorities *feel incoming fuel size should be 1¼ in. top size with little fines below ½ in. uniform size consist. This prevents segregation, blow holes, undue flue-gas pickup of smaller particles.—Ed.*

Underfeed Stoker. Relative absence of small particles of fuel decreases quantity of cinder. This firing method has good reputation for low dust losses. Less than 15% of the ash leaves the furnace with flue gas. J F Barkley, U.S. Bureau of Mines, puts it at 5 to 30%

Most experts *agree coal size is not too critical but preferred choice limits size within a ¾ to 2 in. top size. Usual specifications call for 2 in. nut and slack with no more than 50% through ¼ in. round-hole screen.—Ed.*

Cyclone Burner. Burns a crushed coal, not pulverized, minus ¼ in. size. Most ash leaves in molten form, but about 16% escapes with the gases. Dust has negligible combustible content


All particles easily carried in gas
Pulverized coal
Spreader stoker
33% of ash as flue dust
Traveling-grate stoker
15% of ash as flue dust
Underfeed stoker
Under 15% of ash as flue dust

FIRING METHODS influence size, shape, density of particles and air-stream velocity in which they leave the furnace and the stack

GAS VELOCITY: A SPECIAL PROBLEM

Terminal velocity of any object is the rate at which it falls in a motionless fluid (usually air at 70 F). It is measured for very small particles by placing the particle in an upward moving fluid. That velocity where the particle stays suspended at a fixed elevation is the terminal velocity. An upward velocity greater than the terminal lifts the particle in space. Size, shape, density of particle affects terminal velocity

Spreader stoker, with grate openings 5% of grate area, void areas in ash and coal layer of 30%, has vertical gas velocities as in table II, p 94. Gas velocities, given for above fuel bed (440 to 710 fpm) compared with terminal velocity in table I, show particles of 250 microns and less are carried up in the flue gas at firing rates of 20 lb per sq ft per hr and more. If density of particles is low enough, even 500-840 micron material goes up the flue

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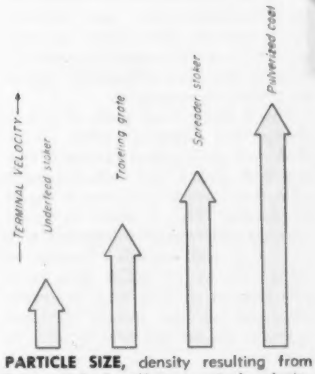


PARTICLE SIZE, density resulting from firing methods affect terminal velocity

STACK DUST Continued

Under furnace heat, above, the formation of cenospheres showed entering particles undergo a change in density that greatly alters terminal velocity. Table III shows size distribution of dust particles leaving a boiler furnace under different firing methods and indicates the problem their control presents.

NOTE: This article is based on "Dust Emission From Coal-Fired Boiler Furnaces," presented before the Midwest Power Conference, Chicago, Ill., April 1951, and the Air Pollution and Smoke Prevention Association of America, Roanoke, Va., May 1951.

I: Terminal Velocities of Dust Particles, 2250-2500 F

Size, micron, dia		44	74	149	250	500	840	1100
Size, sieve mesh		325	200	100	60	35	20	18
		Velocity, fpm						
Density	0.2	0.8	2.2	9	21	71	164	216
	0.5	2.0	5.5	23	52	177	410	540
	1.0	3.9	11.0	39	103	355	820	1080
	1.5	5.9	17.0	67	154	532	1230	1620
	2.0	7.8	21.0	78	206	710	1640	2160
	2.5	9.7	28.0	98	257	890	2050	2700

II: Vertical Gas Velocities In Spreader Stokers

Firing rate—lb/sq ft/hr	20	30	40
Excess, air percent	60	40	30
Entering air, 70 F, fpm	71	93	115
Through grate, fpm	1420	1860	2300
Through ash, 400 F, fpm	384	500	620
Above bed, 2500 F, fpm	440	575	710

III: Size Distribution of Total Dust

Particle size, microns	PC*	Cyclone	SS*	TG*	UF*	UF*
0-10	25	72	11		7	35
10-20	24	15	12	11	8	22
20-30	16	6	9		6	7
30-44	14	2	10		9	8
44-74	13		12	12	8	3
74-149	6	5	17	30	19	25
149+	2		29	47	43	
Total	100	100	100	100	100	100
Tests run	7	2	13	2	8**	1

* PC—pulverized coal
TG—traveling grate
UF—underfeed stoker
SS—spreader stoker

** This set of UF (underfeed stoker) readings were at high-rate operation.

Diesel Instruments and Controls: 8

By EDGAR J KATES
Consulting Engineer, New York, N. Y.

Pointers on Metering Engine Fuel

Good tank gaging and a flexible metering hookup help you in ordering fuel oil, keeping an eagle-eye on plant performance

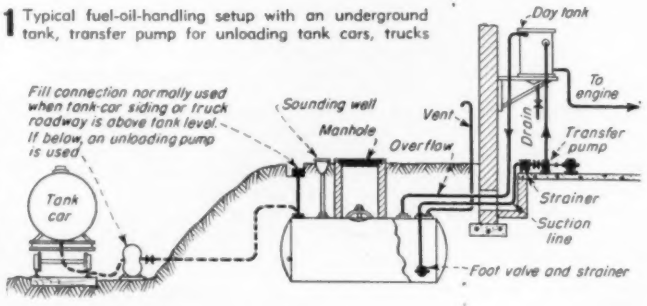
► THE PURPOSE of a fuel-supply system in a diesel-engine plant is to store an adequate supply of fuel oil, clean it, preheat if necessary, and deliver it to fuel-injection pumps of the engine or engines.

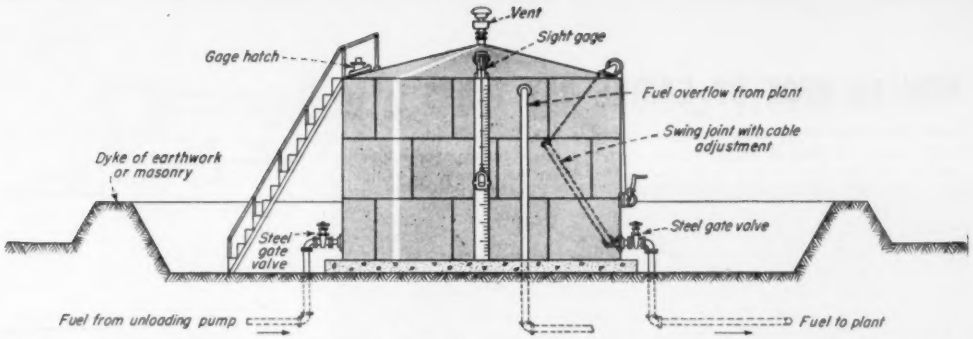
Typical system consists of storage tanks, pumps to transfer oil from delivery point to storage tanks and from these tanks to engine, and strainers, filters and centrifuges needed to insure clean fuel. Instruments and controls for fuel-supply systems include meters or gages to measure fuel quantities, liquid-level indicators and controls, pump controls, foot valves and anti-siphon valves, and, sometimes, flow controls for filters and temperature controls for preheating equipment.

Fig. 1 shows basic parts of a fuel-storage and -handling system. It includes an underground horizontal storage tank and a day tank in engine room, from which fuel flows to engine by gravity. Fig. 2 shows a typical above-ground vertical storage tank with its piping and controls. Purpose of swing-joint on oil outlet pipe is to take cleanest oil from tank, especially when tank has been recently filled and sediment has not had time to settle to bottom.

Tank Gaging. Storage tanks are always provided with means to determine oil level in order to indicate proper time to re-order fuel, also sometimes to measure fuel consumption of entire plant. Day tanks also are always fitted with oil-level indicators. If day-tank supply is under manual control, level indicators tell when refilling is needed; if automatic control, indicator assures operator that pump and control are working. Level indicator in day tank is also useful for measuring fuel consumption. With separate day tanks for each engine, fuel consumption of individual engines can be measured. (Pointers on this later.)

1 Typical fuel-oil-handling setup with an underground tank, transfer pump for unloading tank cars, trucks





2 Typical above-ground storage-tank installation, from DEMA *Standards*, shows float-actuated sight gage and hatch for use of sounding stick. Swing joint on oil outlet pipe permits taking oil from the upper levels, where it is cleanest

PRACTICAL WAYS TO INDICATE OIL LEVEL IN TANKS

Oil-level indicators come in many forms. The simple sounding stick isn't too accurate and may contaminate fuel oil with sand and dirt. In above-ground tanks, Fig. 2, floats are often used—attached to a wire running over a pulley with a weight on the outside end. But this means a hole in the tank top, through which dirt and water may enter. Pulley friction may cause indicator to read incorrectly.

Day tanks are sometimes fitted with gage glasses. These are accurate enough but if glass breaks, oil will flow out onto the plant floor.

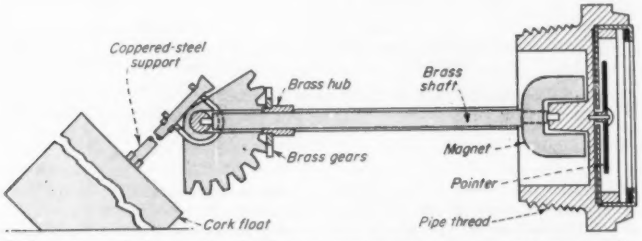
Float Gages. Available tank-level gages may have indicator at the tank or remote from it, at some convenient point. Fig. 3 shows a float-operated direct-indicating level gage, which may be placed in the side of an above-ground tank. Magnets turn the indicator needle. This avoids use of a packing gland, which might leak.

Fig. 4 shows the principle of a float-operated remote-reading gage, which has a hydraulic transmission system. Four bellows—two in indicator and two in actuator at tank—are so joined that indicator follows exactly any movement of float. Twin hydraulic circuits and a simple compensating link at the dial prevent any error due to temperature changes of liquid in connecting tubing. Thus, long lengths of transmission tubing may be used.

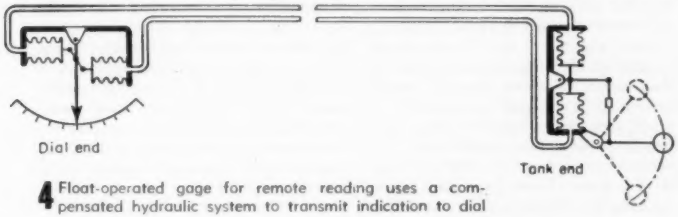
Pneumatic Gage. Main elements of another remote-reading level gage appear schematically in Fig. 5. This works on a pneumatic principle. It establishes hydrostatic balance between head of oil in tank and head of liquid in indicator. Pressure head H, due to oil at level A above zero level B, compresses air in connecting tubing. Pressure so transmitted causes indicator liquid to rise to height h in calibrated gage glass. Dial-type pressure gage may be used instead of gage glass.

Connecting line must be free of oil all the way to zero point B. To be sure of this, pump air into line (using hand pump at indicator) before taking reading. Pump until indicator shows no increase. A continuously operating power-driven pump may be used, with excess air escaping into oil at B.

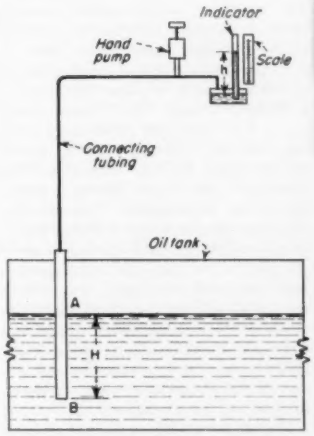
Note that all hydrostatic level gages really show *pressure*, not actual level. Since pressure of any given height of oil depends on oil's density, such a gage is fully accurate only for oil having specific gravity for which instrument was calibrated. Also, atmospheric pressure must exist above oil, or there must be a compensating line.



3 Float-operated direct-acting level gage uses magnets to turn indicator needle. This avoids need for a packing gland, which takes maintenance and might leak



4 Float-operated gage for remote reading uses a compensated hydraulic system to transmit indication to dial



5 Another remote-reading gage employs a pneumatic principle of operation

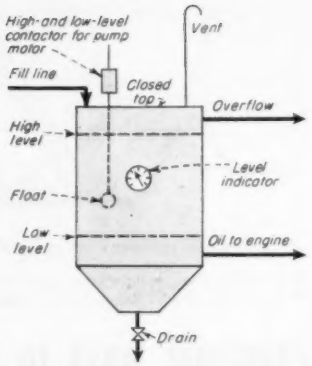
HOW TO HOOK UP ENGINE DAY TANKS

Overhead day tanks assure several hours' supply of clean oil ready for use and at sufficient head to flow to engine by gravity. In multiple-engine plants a common day-tank system may be used; in this case it's a good idea to have two tanks, one being a reserve. This permits cleaning day tank or working on meters without disturbing operation.

Use of an individual day tank for each engine makes it easier to measure oil consumed by each unit. Cleaning and other maintenance can be done while engine is "down" for other reasons.

Filling Tank. Day tanks are usually filled by motor-driven pumps, although hand pumps are sometimes used in small plants (and for emergencies in larger plants). Starting and stopping of motor-driven pumps may be manual or automatic. If automatic, a float in day tank usually operates high- and low-level contactors. Provide day tank with a vent carried well above tank, also with an overflow to a safe point in case of accidental overfilling. Capacity of overhead day tanks is often limited by local safety ordinances.

Connections. Oil line to engine from day tank should connect well above bottom of tank to insure clean oil. Install a drain valve at bottom of tank for removing sludge and water. Conical tank bottom helps settling and draining. Fig. 6 shows typical hookup.



6 Typical day-tank hookup shows high- and low-level contactors for motor

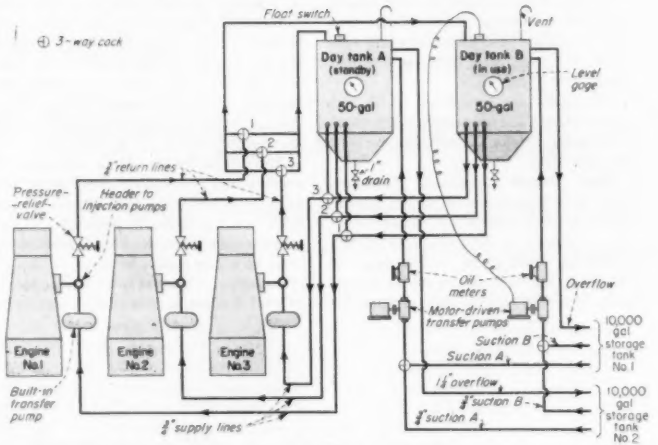
WHAT TO WATCH OUT FOR IN FUEL-OIL-METERING SETUPS

Oil meters may be used at several points in oil-supply systems: (1) in unloading line from tank car or tank truck to storage tank (2) between storage and day tank (3) between day tank and engine. Oil meters are usually of positive-displacement design, using oscillating pistons or wobble plates.

Placing Meters. Meter at location (1) serves as a check on oil purchases. At (2), meter shows oil used by engines, provided it is read when oil in day tank is at a "standard" level. If common day tank is installed, meter shows consumption of plant as a whole. At (3), meter measures oil used by each engine and day-tank level doesn't enter the picture. This last location may not work for small engines because most commercial oil meters are designed for flow rates higher than 10 gph. This corresponds to consumption of a 300-hp engine at about half load.

Flexible Layout. Fig. 7 shows hookup of day tanks and meters used satisfactorily in a 3-unit 750-hp diesel-electric plant in New York City. This plant runs 24 hr per day and utmost reliability is required. Consequently, duplicate day tanks and transfer pumps are installed, as well as independent suction lines to each main storage tank and independent supply and return lines for each engine. Note that each meter is between transfer pump and day tank. Flexible scheme using 3-way cocks permits a day tank to feed any one engine if operator wants to measure its fuel consumption.

Protect meters by strainers in piping ahead of instrument. Always put meter on discharge side of transfer pump or in a gravity line—never on suction side of a pump. If there is any possibility of oil carrying air or gas, provide for adequate venting ahead of the meter. Automatic vent devices are available for this purpose.



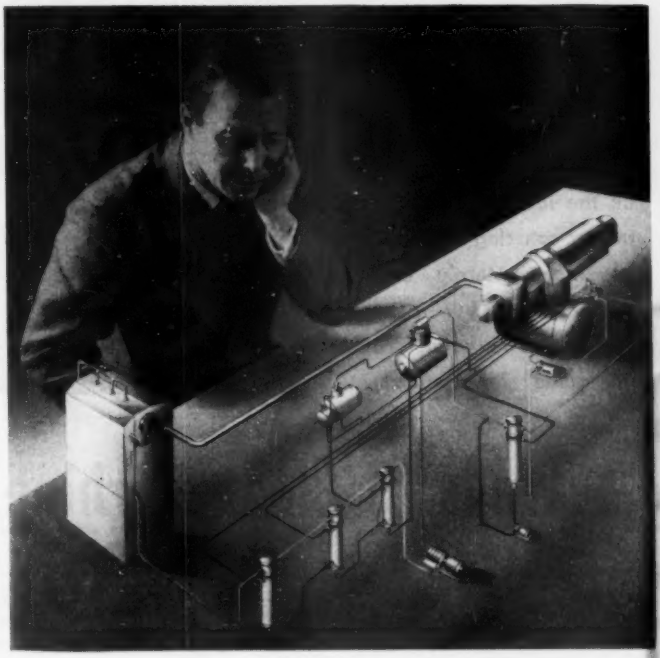
7 Fuel-system hookup used in 3-unit plant has duplicate day tanks and transfer pumps. Use of 3-way cocks permits checking fuel consumption of any one engine

Volume Change. Fuel oil changes in volume about 1% for a temperature change of 25 F. Since commercial deliveries are billed on basis of *gallons* corrected to standard temperature of 60 F, some users apply a temperature correction to delivered gallonage. This requires a thermometer in the pipe close to the meter. Some large fuel meters have built-in thermometers and adjustments to compensate for temperature variations.

Day tanks and meters are sometimes dispensed with on small engines. Engine is fitted with built-in transfer pump which lifts oil from underground storage tank and feeds directly to supply chamber of engine fuel-injection pump. Transfer pump supplies surplus oil to header feeding fuel-injection pump; relief valve on header returns excess oil to tank and maintains pressure on fuel-injection pump. With this scheme, engine fuel consumption can be measured only by gaging tank.

(*Continued on page 200*)

Could You Cure This Headache?



▶ **An engineer who specializes in starting new plants and trouble-shooting in old ones runs into problems that the average operator never meets and design engineers never anticipate . . .**

▶ **DON SWIFT, of Ebasco Services Inc, is such a specialist. He begins here a series of "shorts" on power - plant headaches he's dealt with and how they were solved. Some of them could happen to you. Test your ingenuity —see if you can spot the answer before Don gives it to you . . .**

▶ **Start by following him through Case No. 1—the one that gave him the puzzled expression he wears in picture at the right . . .**

Case No.1—THE OBSCURE OIL LEAK

▶ THIS IS THE STORY of a single-unit 650-psig 825-F 35,000 kw power plant that really became oil conscious. One day, after it had run several years, the operators noticed oil in the gage glass of one of the two gas-fired boilers. In a short time it appeared in the other boiler, the deaerator, the gage glasses of the feedwater heaters, and in the condenser.

Pumps were checked, fuel-oil heaters tested for leaks, and oil-heater condensate was thrown away to be sure no fuel oil could enter the system. All possible sources of oil entry into the system were considered, checked and eliminated.

Lubricating-oil coolers were cooled with service water, so oil could not enter from this location. Gage glasses were blown down and boiler alkalinity was kept high to eliminate or break down the oil as much as possible. To try to get rid of it, boilers were drained and washed several times.

We lived with the oil for several months with no resulting damage. Evidently the quantity was only a small percentage of the water volume. The hunt went on, however, under the constant threat of boiler or furnace tube burn-out. But there seemed to be no solution.

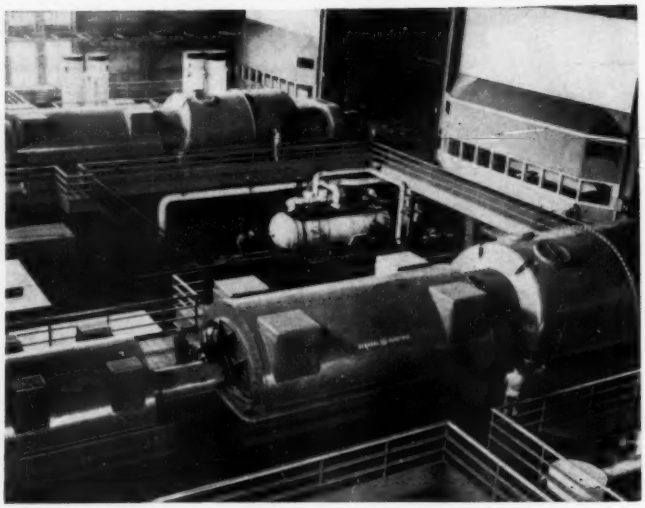
Then one day came the thought: "Where in the plant are oil and steam, or condensate, in close proximity with the oil at a higher pressure?" The answer was fairly obvious: "At the junction of exhaust hood and rear-turbine bearing."

It sounded like a good possibility even though where or how the leakage could occur was still a mystery. The turbine was shut down at the first opportunity and we inspected the exhaust hood's inner surface. On the rear wall of the exhaust casing below the bulge of the rear bearing's oil-drain chamber we found a faint streak of oil. Close examination showed a small, slightly porous section of the casting allowed oil to seep through, particularly when the turbine ran with warm, thin oil and a high vacuum to help pull the oil in.

We dismantled the bearing and drilled out the porous section of the casting, finally plugging it. We cleaned out the oil in condensate system and boilers as thoroughly as we could. The unit then went back, grinding out its thousands of kilowatts. Evidently the trouble had been found. Evidences of oil faded and disappeared altogether.

But the operators still murmur and turn in their sleep as they dream about oil leaks. Then they wake up and think how lucky they were that oil had caused no damage to the boilers. If the oil had leaked at a greater rate or had been of higher viscosity they would have had real trouble on their hands.

TANDEM-COMPOUND steam-turbine generator sets at Sewaren, N. J. But large or small, once installed and running, it's the plant operator who tells when and how the lube system should be cleaned. Make the first complete inspection after the unit runs for one year →



Troublefree operation of a steam turbine hinges largely on the lube system. Foreign matter can clog oil lines, foul governors. Merely draining oil removes but a small part of the material. Follow this guide* for practical . . .

. . . Ways to Clean Turbine Lube System

► PROPERLY APPLIED, oil-purifying equipment goes far to prevent buildup of insoluble foreign matter in the lube system. Nevertheless, a thorough cleaning is in order from time to time. Turbine manufacturers usually recommend that a new turbine be taken down for complete general inspection within its first year of operation. This is an excellent initial opportunity to inspect the oil system for evidences of deposits, corrosion and abnormal wear.

WHEN TO CLEAN:

When the turbine is placed in service keep a close watch until operating conditions have stabilized. This means normal oil outlet and inlet temperatures to bearings, coolers and other parts in the lube system. Keep record of temperature differentials across bearings and coolers; this fits well in the daily log. And when this temperature differential at the coolers departs from the established norm you may have deposits accumulating on either oil or water side of cooler.

Take frequent oil samples for visual inspection; note any presence of water, emulsions or suspended matter. Complete laboratory tests made upon periodic samples tell whether any significant change is occurring in the oil that might tend to speed up deposit formation. Frequent check on the oil-sump drain and the oil-purifying equipment also helps indicate rate of deposit accumulation.

Any abnormal condition noted is a warning that trouble may be brewing in the turbine system. Some of these unusual conditions may be increased rate of deposits removed by oil-purifying equipment, abnormal oil pressure at any point in the system or oil-purifying equipment, water in the oil, change in temperature differential, change in oil test. By careful inspection, the trouble source is usually found. Then remove any deposits that have accumulated in the system.

Typical deposits may range from a viscous-oil film to solids that completely choke oil passages. Method of cleaning depends on amount and nature of insoluble material present. Laboratory examination of sample deposits helps determine the best means of removal. It is impractical to make any all-inclusive statement on what is an appreciable amount of deposit; your own experience should serve as a guide. Before reaching final decision on means of removal, check with turbine manufacturer and oil supplier.

FOR SHIPSHAPE OIL COOLERS:

Any marked change in oil-temperature differential across the cooler, with no change in water flow or water temperature, may indicate excessive build-up of deposits.

Hot water or steam washing or petroleum flushing-oil are usually used for cleaning oil side of coolers. But regardless of material, all traces of the cleaner must be removed; otherwise the new oil charge may be contaminated. Any cleaner should not attach to finish since this may lead to formation of metallic soaps that can stabilize oil-water emulsions. Cases are on record where cleaners have reacted with cooler-tube surfaces to make them extremely effective catalysts to hasten turbine oil oxidation. After cleaning, run a hydrostatic test on the cooler as a check for leaks.

VARIOUS METHODS FOR OIL SYSTEM:

The following methods have been used successfully for cleaning stationary units of varying sizes. The method selected depends largely on results of lab examination of deposits and cleaning materials, facilities and time available. Regardless of method selected, when appreciable quantities of de-

*Based on report by Joint ASTM-ASME Committee on Turbine Lubrication.

WITH A NEW TURBINE . . .

. . . the problem is a little different. Here the plant operator's big job is to see that all rust-preventive coatings (put on by the manufacturer) and dirt are completely removed before the regular lube charge is added.

Initial inspection shows extent of cleaning job required before oil or flushing fluid is introduced into system. In addition to removing rust-preventive film, wire-brushing, blasting and sweeping are often necessary to remove welding shot, chips, sand, etc.

Then after initial inspection and manual cleaning, send a flushing charge through. This may be followed by a displacement oil charge.

For complete details on preparing a new turbine lube system for service, see POWER, Nov 1948, p 85.

posits are present, and accessible, the bulk of deposits should be removed manually.

Steam and Hot Water. Tarry matter from oil and oil-water emulsions can often be removed from turbine parts by steam or hot-water washing. Clean parts individually. Don't blow steam or hot water into bearings or governor mechanism that should be cleaned manually. Steam is preferred over hot water.

But when using hot water, try boiler feedwater above 180 F. Send it through the piping at high speed. A more thorough cleaning results if piping is dismantled. Clean bearing pedestals and oil reservoirs by sending a stream of hot water against the hardened surfaces. Dry the parts immediately with clean, dry air.

Steam at high velocity has been used with good success. Use a flexible steam hose whose end is covered with a tapped cap. Insert in the tapped hole a short nipple about ¼-in. diameter. Then steam out pedestals, reservoirs and pipes. Dry carefully with clean, dry compressed air.

Since steam or hot-water washing removes protective oily films from metal surfaces, they are prone to rust. Hence the complete lube system should be protected quickly with a rust-inhibited turbine or flushing oil. Dip governor parts in rust-inhibited oil right after cleaning. Assemble unit and circulate the rust-inhibited or flushing oil through it as soon as possible.

CLEANING WITH FLUSHING OIL:

Arrange oiling system for maximum oil-flow velocity. Naturally, the precise steps depend on turbine construction. In some instances, you get maximum flow by removing upper halves of bearings and any external orifices. On the other hand, you may be able to roll the lower halves of bearings about the shaft enough to uncover oil-supply passages.

Then place a sufficient charge for flushing (50-75% normal oil charge) of rust-inhibited turbine oil in the system. Heat the oil to between 150 and 180 F. Maintain it at this temperature from 4 to 24 hr while it is being circulated by the turbine auxiliary oil pump. The exact time depends on turbine size or nature and amount of deposit.

Oil may be heated by passing hot water through the water section of the cooler. The same results are obtained by installing a temporary low-pressure—about 5 lb max—steam coil in the oil reservoir. Keep venting devices and continuous bypass purifiers operating during entire flushing period. This is an important point.

Governor. Oil piping, passages, and parts of governing system that come in contact with oil must be cleaned. Do this without scoring working parts of governing mechanism. Remove pilot valves and pistons—pistons may be blocked in their open position—during the flushing operation. It may be wise to blank off high-pressure oil passages to the governor and other control mechanisms during early stages of flushing. Toward end of flushing period, remove blank so the relatively clean flushing oil can flow through the oil piping and passages of governing system. Manually clean all governor parts with lintless cloth after flushing.

Check strainers and other oil-purifying equipment to help determine time required for flushing. When successive inspections show no noticeable increase in deposits you can be reasonably sure all contaminants have been removed from the system. By putting clean lintless cloth bags inside the strainers you get a ready check on progress of cleaning.

AFTER FLUSHING:

When flushing is completed, drain oil from tank, coolers and oil-purifying equipment while it is still hot. But continue venting until system returns to about room temperature. Drain all those spots that could serve as traps. Then inspect all accessible parts of lube system, removing any remaining deposits manually with lint-free cloth.

Then return bearings and piping to their original locations and complete the turbine assembly. Next charge the turbine lube system with a supply of clean oil of the grade recommended for normal operation. Give the customary operational check to each unit before placing the turbine in regular service. At the end of this step many operators consider it good practice to make a final check on the cleanliness of the oiling system. So, where conditions permit, oil may be temporarily removed from the system so the latter can be given a thorough inspection. If this is impossible or not practicable, at least check the strainers and oil-purifying equipment for any unusual deposits.

Cleaning During Service. Often a lightly-sludged unit cannot be taken out of service long enough for thorough cleaning before an oil change. In such cases, continuous bypass circulation of oil in the system through a clay filter will remove solids and partly soluble oil degradation products from the system. Keep in mind that passing an inhibited oil through clay removes some additives. Check with your oil supplier before using this procedure.

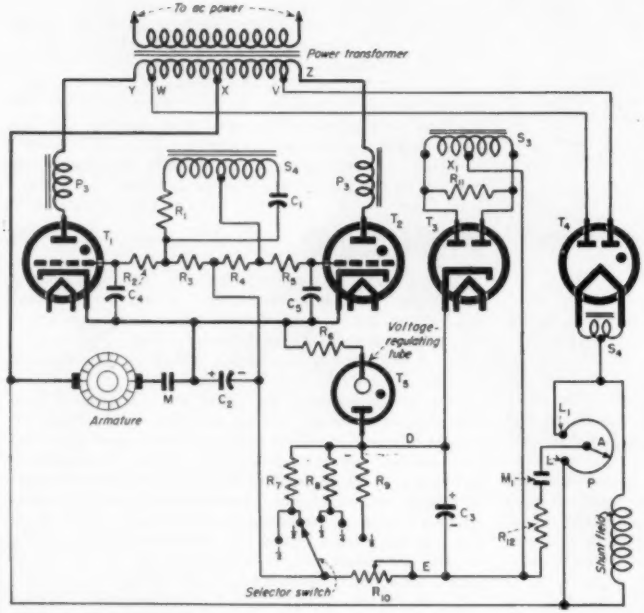
Watch governor operation and bearing temperatures carefully when following this latter procedure. Ofter solid particles are loosened that are large enough to restrict oil flow and interfere with operation.

It is not practical to use the methods outlined above in cleaning marine turbine units. Fundamentally, such units have more extensive piping in addition to gear sets with their additional lubricating devices. Hence the marine oil system is much more complicated than those of stationary units. Inaccessibility of oil piping in marine units makes it impractical to clean by flushing with hot water or steam. The complex oiling system of marine units may permit greater buildup of deposits in inaccessible locations. Hence, with this system deposits can best be removed by consecutive flushing with a rust-inhibited flushing oil. This should be followed by a turbine oil of the grade recommended for regular operation.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

38—Electronic Control for Dc Motors: I



SPEED CONTROL. Wiring diagram for a dc motor control that adjusts speed by armature voltage, has IR-drop compensation to hold speed constant at any setting

► ELECTRONIC EQUIPMENT for powering dc motors and controlling their speed from an ac system is developed in many forms. Basically they have much in common, but they may differ widely in the way they accomplish their control functions. Let's delve a little more into these controls to study some of their refinements.

Added Features. The diagram shows in simplified form a Westinghouse electronic motor drive, Mot-o-trol, for fractional-horsepower motors. The equipment, as in May POWER, controls speed by armature voltage only. It has features, however, such as armature *IR*-drop compensation to hold constant speed at any given setting. Also, an armature-current limit is included to prevent overloading motor excessively during starting and at other times.

For simplicity the starting circuits, the transformer that supplies them, and the cathode heaters are not shown. On this unit there is no time-delay relay so after the power switch is closed, wait 30 seconds to give the tube cathodes time to heat to operating temperature, for starting cold. After the cathodes have been properly heated the unit can start and stop without any delay.

Field Circuit. When the power switch is closed the field circuit becomes alive immediately. This circuit is from X on the power transformer through the shunt-field coils, tube T_4 to W or V on the transformer depending on its polarity. Tube T_4 is a gas-filled unit but can be put into service at once. It has a direct-heated cathode that reaches operating temperature in a few seconds. Also, the field coils are a highly inductive load through which normal current, which is small, does not reach full value for several seconds. Consequently, tube T_4 can be connected to the circuit without time delay.

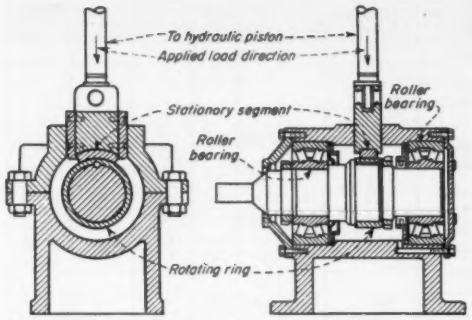
When the start button (not shown) is pressed contact M in the armature circuit and M_1 in the speed-control circuit close. When contact M closes a circuit is completed from X on the power transformer through the armature, contact M, either tube T_1 or T_2 to Y or Z on the transformer depending on its polarity. That is all there is to the motor circuits, the rest has to do with speed control of the motor.

Grid Voltages. Output of the armature thyratrons is controlled by a combination of an adjustable dc bias and an ac rider voltage such as we studied in several previous articles. The ac grid-rider voltage is obtained from the phase-shift network transformer secondary S_4, resistors R_1, R_2 and R_4 and capacitor C_4. This network applies an ac voltage to the grids of T_1 and T_2 120 deg out of phase with that from cathode to anode of the tubes.

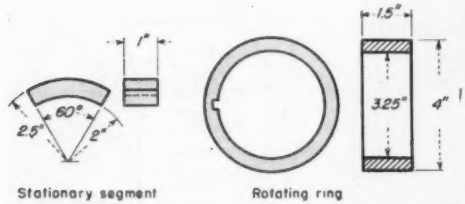
The dc grid voltage is that across the armature, minus part of the field voltage across speed-control potentiometer P, minus the volts' drop across *IR*-drop compensation resistor R_{10}. This voltage is applied from X on the power transformer through P to arm A, contact M_1, resistors R_{12} and R_{10}, to the tap between R_8 and R_9, and to the grid of each tube.

When arm A is moved clockwise to L_1, potentiometer P is out of the grid circuit, and the volts' drop across the armature is applied through M_1, resistors R_{12} and R_{10} to the grids. Dc voltage on the grids is now equal to the armature volts, minus that across R_{10}. This voltage is much higher than that on the tubes' cathodes, so the grids have a large minus bias with respect to the cathodes. This lowers the ac rider so it crosses the critical voltage near the end of the anode voltage wave and reduces the tubes' output, and likewise motor speed, to a low value.

(*Continued on page* 196)



1 Ring material tester consists of shaft supported in high-capacity bearings. Rotating wearing ring is keyed to shaft



2 Dimensions of the wearing rings and metal segments, that were tested at pressures ranging from 50 psi to 300 psi

Material combinations		Unit bearing load, psi
Stationary ring	Rotating ring	0 50 100 150 200 250 300
810 Bearium bronze	Type 410 Colmonoy	
810 Bearium bronze	Type 410, 300 Br	
Navy M bronze	18-8, type W, 400 Br	
Type 410, 300 Br	Hard bronze, 90 Cu, 10 Sn	
84 Bearium bronze	Type 410, 300 Br	
Hard bronze, 90 Cu, 10 Sn	Hard bronze, 90 Cu, 10 Sn	
Bronze, 85-5-5-5	Aluminum bronze	
Navy M bronze	18-8, type 302, Nitrided	
810 Bearium bronze	Type 440, 450 Br	
810 Bearium bronze	Type 410, 350 Br	
Navy M bronze	Type 410, Nitrided	
810 Bearing bronze	Type 410, Stellite No. 1	
Type 410, annealed	Type 410, Stellite No. 1	
25-20 chrome-nickel	25-20 chrome-nickel	
Type 410, Stellite No. 6	Type 410, Stellite, No. 6	
Type 410, 300 Br	Type 410, 350 Br	
18-8, Type W, 300 Br	18-8, type 302, Stellite No. 1	
Niresist No. 1	18-8, type W, 400 Br	
Niresist No. 2	Type 410 Colmonoy	
1.25 nickel cast iron	Type 410, 300 Br	
1.25 nickel cast iron	Type 410, Stellite No. 1	
18-8 (302) Stellite No. 6	18-8 (302) Stellite No. 1	
Niresist No. 1	Type 410, Nitrided	
Type 410 Colmonoy	Type 410 Colmonoy	
18-8 (302) Stellite No. 1	18-8 (302) Stellite No. 1	

3 Unit pressures in psi at which galling occurred on test specimens. For several factors, consider results relative

How Wearing Rings Are Selected For Centrifugal Pumps

By **H E TRACY**, *Engineer*
Byron Jackson Company

The kinds of ring material may mean the difference between a troublefree, efficient pump and a headache for you. Here are test results that will determine the best metal combinations. They are classed as good, fair or poor, from these findings

► CENTRIFUGAL-PUMP WEARING RINGS must be made of many materials to meet the needs of the vast number of liquids pumped. Experience shows that some wearing-ring material combinations in common use gall more readily than others, thus requiring greater clearance for successful operation. In the past, only this experience guided us in material selections and required clearances. To obtain relative galling characteristics of materials, we constructed a machine for testing different metal combinations under controlled conditions.

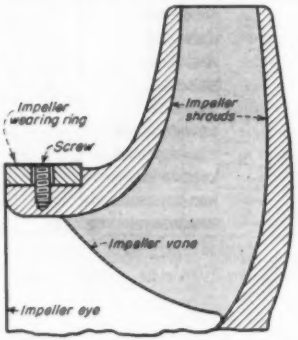
Wearing Rings Tested. This tester, Fig. 1, consists of a horizontal shaft supported by high-capacity roller bearings mounted in a horizontally split housing. A ring is keyed to the rotating shaft, and the stationary segment clamped to a piston. Oil seals are installed at the inboard end of both bearings to protect them from particles worn from the test specimens. Tester connects to 10-hp 3550-rpm motor.

Fig. 2 shows dimensions of ring and segment. The 4-in. ring diameter gives a surface speed of 3660 ft per min. After the machine is assembled with specimen in place, the fit between the rotating ring and stationary segment is checked with prussian blue and lapped to obtain maximum contact and the tester filled with SAE-20 oil. Loading pressure between the rotating ring and stationary segment is produced with a hand-operated hydraulic pump, connected to a cylinder containing the piston to which the stationary segment is clamped. Pressure on the rotating ring is accurately maintained with a dead-weight tester.

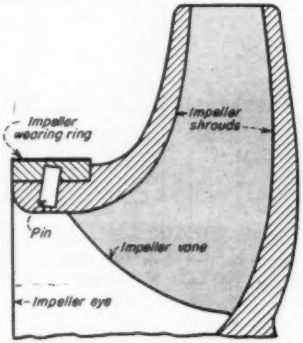
On each set of specimens, unit bearing load is brought up to 50 psi, the tester started and, at the end of a 5-min run, specimens are examined. If no galling has occurred, pressure is raised

Metals		B10 Bearium bronze	B4 Bearium bronze	Navy M bronze	Hard bronze	Bronze 85-5-5-5	Aluminum bronze	25-20 chrome nickel	Type 410	Type 440	Type 302	18-8 Type W	Niresist No. 1	Niresist No. 2
Copper	Cu	70	70	88	90	85	85.21							
Tin	Sn	10	4	5	10	5								
Zinc	Zn			4.75		5								
Lead	Pb	20	26	2.05		5								
Phosphorous	P			0.05				0.018	0.015	0.020	0.022			
Aluminum	Al						10.70					0.08		
Carbon	C							0.18	0.08	1.04	0.10	0.05	3.15	3.0
Manganese	Mn							1.85	42	0.48	0.51	0.60	1.25	1.25
Sulphur	S							0.013	0.015	0.020	0.022	0.007		
Chromium	Cr							25.08	12.15	16.61	18.47	17.2	2.25	2.25
Nickel	Ni							20.78	0.38	0.21	9.32	7.01	15.0	20.0
Molybdenum	Mo									0.5				
Silicon	Si							0.47	0.30	0.44	0.33		2.0	2.0
Titanium	Ti											0.79		

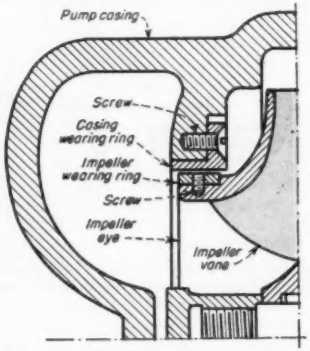
4 Chemical-analysis table shows composition of each material in wearing rings. Materials with hardness below 300 Brinell were lathe turned; those above 300, finished by grinding. Ring's final surface was same as in commercial pumps



8 Ring secured on impeller by three screws tapped into ring, impeller



9 Ring fastened to impeller by pin, put in from inside impeller eye



10 Rings fastened to impeller and casings with screws in tapped holes

progressively in 50-psi increments until galling occurs.

Fig. 3 shows unit bearing pressures in pounds per square inch, at which galling occurred. Results must be considered as relative in that we cannot establish a definite unit bearing load for field operation or predict with accuracy lubricating effect of various pumped liquids. From routine pump tests in the laboratory and from field experience we can, in a broad sense, classify galling characteristics of material combinations commonly used.

Materials Qualities. Material combinations classified as Good, Fig. 5, rarely gall. Material combinations classified as Fair gall occasionally. Material combinations classified as Poor gall frequently unless greater than standard clearances are allowed. From this experience record, we can evaluate results shown in Fig. 3 by placing each combination in its approximate relative position.

For example, B10 Bearium bronze in combination with Type 410 Colmonoy at 350 Brinell is known to be good. Galling occurred at 200 psi. Knowing that this combination is good and that galling occurred at 200 psi would lead us to believe that B10 Bearium bronze in combination with Type 440 at 450 Brinell would be equally good as this combination also galled at 200 psi. B10 Bearium bronze in combination with Type 410 overlaid with stellite No. 1 should be superior in that galling occurred at 300 psi.

The fact that Type 410 was used as a base metal has no bearing on the success of this combination. Any material properly overlaid with stellite No. 1 should give equal results in combination with B10 Bearium bronze. Knowing from experience that type 410 at 300 Brinell in combination with Type 410 at 350 Brinell galls occasionally would indicate that some trouble might be experienced with other material combinations that gall at 100 psi.

In combination with 25-20 chrome nickel, 25-20 chrome nickel galled at 50 psi. This combination is bad, requiring above-standard clearance to prevent galling. Although we hesitate to draw conclusions, a comparison of experience with test results would indicate that material combinations can be approximately classified as:

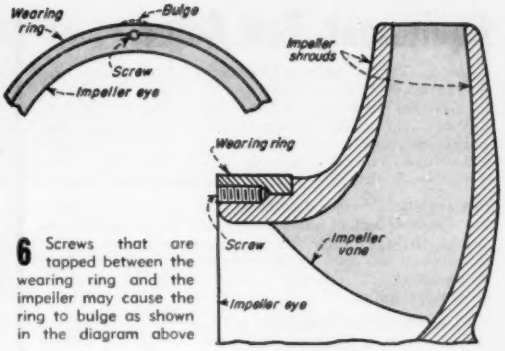
1. Good material combinations galled at or beyond 150 psi in our tester.
2. Fair material combinations galled at 100 psi.
3. Poor material combinations galled at 50 psi.

At this time relative galling tests are only partially complete. A number of others are scheduled. Fig. 5 lists a few of the more popular combinations not yet tested, but we feel sure tests will substantiate our classifications. The analysis table, Fig. 4, shows composition of each material. For materials where the percentages do not add up to 100 the balance is iron.

Surface finish determines to a considerable extent the bearing load that can be reached. Materials having a hardness below 300 Brinell were lathe turned. Materials with a hardness of 300 Brinell and above were finished by grinding. Final surface condition is the same as on wearing rings in pumps.

Materials		Galling characteristics	Unit bearing pressure, psi
Casing wearing ring	Impeller wearing ring		
Bronze 85-5-5-5	Aluminum bronze	Good	150
84 Bearium bronze	Type 410, 300 Br	Good	150
810 Bearium bronze	Type 410, 350 Br	Good	200
25-20 chrome nickel	25-20 chrome nickel	Poor	50
Type 410, 300 Br	Type 410, 350 Br	Fair	100
Stellite No. 1	Stellite No. 1	Good	250
18-8 Stainless	18-8 Stainless	Poor	Not tested
Type 420, 400 Br	Stellite No. 1	Good	Not tested
Cast iron	Cast iron	Good	Not tested

5 Material classified as Good rarely galls, Fair galls at times, while Poor often galls with the standard clearances



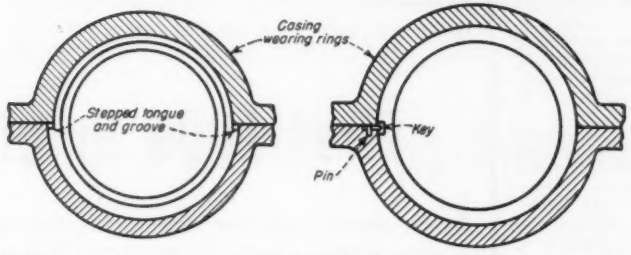
6 Screws that are tapped between the wearing ring and the impeller may cause the ring to bulge as shown in the diagram above

7 One way to secure ring taps screws into ring and impeller

Recommended Clearance for Running Fits of Wearing Rings. Stage Pieces and Throttle Bushing *

Ring dia, in.	Relative Galling Characteristics		
	Good	Fair	Poor
3 - 3.499	0.009	0.012	0.015
3.5 - 3.999	0.010	0.014	0.018
4 - 4.499	0.011	0.015	0.018
4.5 - 4.999	0.012	0.016	0.021
5 - 5.999	0.013	0.017	0.021
6 - 6.999	0.014	0.018	0.025
7 - 7.999	0.015	0.019	0.025
8 - 8.999	0.016	0.020	0.028
9 - 9.999	0.017	0.021	0.028
10 - 10.999	0.018	0.022	0.031
11 - 11.999	0.019	0.023	0.031

*Tolerance: All bores +0.001; all turns —0.001.



11 Horizontally divided casing ring, held in place by tongue and groove

12 Horizontally split casing ring, held by key to between the two halves

Wearing-Ring Clearance. In table, *right*, we classify wearing-ring materials in three relative galling characteristic groups: Good, Fair and Poor, and show recommended clearance for each group. When material selection is at our option, we pick those that best resist corrosion of the pumped liquid and that have the best nongalling properties. Usually these can be selected so clearance requirements fall into group Good or Fair.

Sometimes, when materials are specified by the buyer or for competitive reasons, we must use those with clearances shown in column Poor. For example, 25-20 chrome-nickel in combination with 25-20 chrome-nickel is classed as Poor. This material overlaid with stellite No. 1 can be classed as Good, but its cost is much higher.

Heat Expansion. In addition to selecting materials that will give longest life and not gall, expansion because of increased temperatures must be considered. Impeller wearing rings in hot-service pumps must not expand away from the impeller when the unit is brought up to temperature. Materials with a similar coefficient of expansion must be used in the shaft, impeller, impeller wearing rings, casing wearing rings and casing.

Wearing-Ring Installation. Well-constructed pumps have wearing rings shrunk to the impeller and securely pinned in place to prevent movement due to rubbing or a partial seizure. Normal procedure is first to shrink impeller wearing rings to the impeller and pin, then heat and shrink the impeller with its rings to the shaft. Interference between impeller wearing ring and impeller is 0.001 to 0.0015 in. for ring diameters ranging from 2½ to 6 in.; 0.002 to 0.0025 in. is used for rings 6 1/16 to 12 in. in diameter.

Interference between impeller and impeller wearing ring and between impeller and shaft is held to the minimum that assures a tight fit. When shrunk to an impeller, the wearing ring is under tension. When the impeller with its ring is shrunk to the shaft, this tension increases because expanding the impeller bore also expands the ring fit.

Wearing rings hardened by heat treatment, Types 410, 440, etc, become more brittle as hardness increases. Occasionally, rings of extreme hardness crack during operation due to this tension. By holding interference to a minimum and by limiting hardness of these materials, this trouble is eliminated. We have set a hardness limit of 450 Brinell for Type 440 Colmonoy, and 325 Brinell for Type 410.

Wearing-Ring Fastening. In addition to a shrink fit, impeller wearing rings are held in place with threaded pins. Two methods are in general use. One is to drill and tap for screws at the joint between the impeller and impeller wearing ring, Fig. 7.

The pin acts as a key engaging both the impeller and wearing ring. As drilling and tapping must be done with the ring in place, this method is limited to the softer materials, such as bronze and cast iron, or soft base metals overlaid with stellite, Colmonoy or Stoodite. Although this method is used, it is not considered good practice. Threads must

(*Continued on page 202*)

Here's your quick review of

Equipment, Test Setup

Late in 1949, full-scale coal-burning test began at Dunkirk, N. Y. plant of American Locomotive Co. Test plant consisted of a Houdry-process gas turbine lent to LDC by the U.S. Bureau of Mines, plus fuel-preparation, firing and flyash separation equipment designed by Locomotive Development Committee engineers. For details see POWER, May 1950, p 80. Briefly here's the setup with changes experience dictated:

Test Layout. Turbine plant is supplied by two combustors. One simulates half of coal-burning setup for locomotive (an oil-fired air heater takes the place of a regenerator). Other combustor is oil-fired. Output temperature is controlled to reduce 1300-F gas from coal combustor to 950 F, safe limit for Houdry turbine.

Coal combustor is essentially a film-cooled stainless-steel enlargement of a jet-engine combustor. Primary air carries coal at ratio of one lb coal per lb air. Keeping air velocity above 50 fps eliminates possibility of flashback in burner.

Principal design problem is to devise method of support to keep film-cooling slots open after metal is hot. Rings must be allowed to expand radially but restrained axially. A "strong-back" arrangement has given more than 250 hr satisfactory service and will be used in the locomotive. Another design, affording more radial flexibility, is being tested.

Annular burner developed at Dunkirk has a Peabody wide-range oil burner in center, cooled by secondary air. Coal-air stream swirls out of burner with clockwise rotation from tangential inlet. Secondary air is given a counterclockwise spin by vanes. Resulting turbulence keeps flame short. Additional air enters through slots to cool combustor head.

An oil-fired igniter in combustor head uses a small stream of "ram" air to bend a hot spark into oil spray, keeping spark plug clean and cool. A "flame-on" indicator is being developed to replace present sight glasses. It uses two chromel-alumel junctions. One is exposed to ram air and shielded from flame. The other "sees" flame directly. Small emf generated by thermocouple feeds to a magnetic amplifier to operate a relay.

Combustion efficiency of design to be used in locomotive depends mainly on coal fineness and air-fuel ratio. If coal fineness is held at about 97% through 100 mesh and 90% through 200, following combustion efficiencies may be expected:

Temperature rise, F	300	400	500	600	700
Combustion efficiency, %	81	83	86	93	95

Using a similar film-cooled combustor, Canadian Bureau of Mines finds efficiency varies directly with volatile content. Low-volatile coals may require a hot-wall (ceramic) combustor.

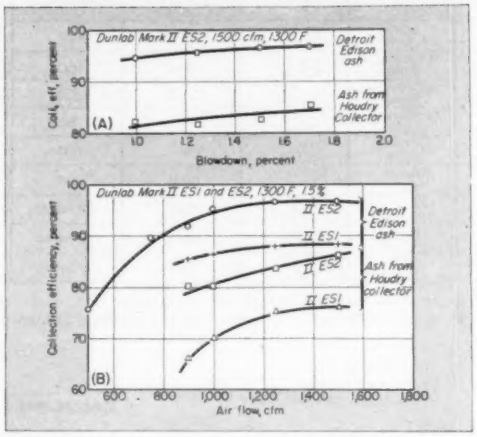
Coal preparation system has needed only minor changes. An Iron Fireman stoker delivers coal from bunker to a small tank, which supplies a Whiting high-speed impact mill. Its blower delivers conveying air, pulverized coal to separator at top of storage tank. Most of air recirculates through mill.

Two Fuller rotary level-indicators control system. First calls for coal from the mill when tank level falls below set point. Mill feeder supplies coal until level is restored. Second indicator starts stoker when coal is needed in mill tank, stops it when tank is full.

Feeding, Control. Principal trouble with drum feeders has been leakage of highly aerated coal between drum and housing. Feeder in current use has two counter-rotating drums, each comprising four small Jabsco rubber pump impellers. Feeder drive is a one-hp Vickers hydraulic transmission, output speed being regulated by turbine operator through a remotely controlled throttle. Response of turbine rotative speed to change in feed rate is virtually instantaneous.

Coal Pump. Essentially a star feeder with very small clearances, LDC coal pump (previously described) transports pulverized coal from atmospheric-pressure area to high pressure. In its latest version, leakage across rotor faces has been reduced by a new type seal. Other design changes increase rigidity, provide replaceable wear plates, improve venting.

BLADE EROSION REDUCED BY...



1 Tests on single Dunlab tube, Fig. 2, show flat curve of efficiency vs blowdown and efficiency gain at higher flows

First 1000 Hr of

Erosion attack on blades during early testing spurred further activity on flyash separating equipment. New collector tube shows promise

► AT THE 1950 MIDWEST POWER CONFERENCE, John Yellott* told what interested engineers were waiting to hear: a full-scale gas turbine had run on pulverized coal, POWER, May '50, p 80. This year he reports first 1000-hr operation.

No. 1 Problem. Not unexpectedly, his report dealt with troubles met and cures tried. Some minor problems are briefed in panel, *left*, with a quick review of the test setup. Here we summarize the major part of his report, dealing with the No. 1 problem—ash removal.

As previously described, the full-scale test plant began life with a 2-stage ash-separation system. Combustion products discharged into a "louver" separator for large ash particles and then into a battery of 18 straight-through tubes.

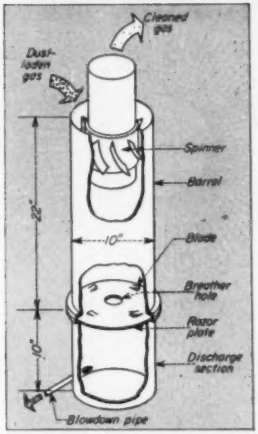
Louver separator resembles a venetian blind rolled into a cone, with ash-laden air entering large end. Air and fine ash particles can make abrupt change in direction, but larger particles and about 4% of air go out louver blowdown line. Louver serves also to eliminate temperature stratification.

Building up of ash deposits on louver limits operation. After 35-40 hr at fixed firing rate, louver area becomes restricted, pressure drop excessive. At shutdown, louver cools quickly and metal rings shrink more quickly than ash. Most cracks off, remainder is easily removed by hand.

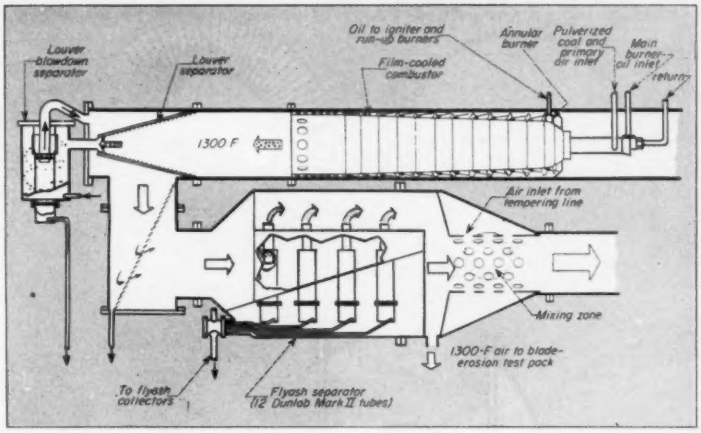
Blowdown Separator. Because 4% air loss can't be tolerated, a blowdown separator concentrates ash into small stream of air. Most blowdown flow returns downstream of louver.

* Director of Research, Locomotive Development Committee, Bituminous Coal Research, Inc. Coauthors of the report were Peter R. Brindley and Frederick D. Buckley.

...NEW COLLECTOR TUBE, CHANGES IN FLYASH SEPARATING LAYOUT



2 In Dunlab tube dust-laden air enters lower discharge section through bladed openings. Cleaned air flows out center



3 Separator used during last 250 hr has louver with blowdown separator and main collector using new Dunlab tubes

Coal-Burning Gas-Turbine Tests

Separator is a 10-in. Dunlab tube (see later) in a 20-in. cylinder. Deflector plate makes air revolve around inner tube and carry finer particles through ¼-in. screen into Dunlab tube. This separates ash from air and blows ash out in a 15-cfm stream from discharge pot. Cleaned air spins back up through tube and re-enters main air stream.

Larger ash particles, stopped by screen, drop to bottom of outer cylinder, where they meet a tangential jet of cold air. Jet action grinds pieces by attrition and carries resulting finer particles up through screen. Cold jet also quenches burning ash. Louver and blowdown separator dispose of larger ash particles at a cost of 0.1% of air flow to louver.

Flyash Collection. Early attempts to use small-diameter cyclones to separate fine ash particles were defeated by combustible nature of ash. With high-volatile coal and combustion efficiency of 95%, ash has about 35% carbon. This must be cooled below 600 F before it ceases to burn.

Separators for Houdry unit have thus been designed for continuous blowdown. Separator used during first 500 hr had 10% blowdown. It operated without burning or plugging but allowed too much plus-10-micron material to enter turbine. High efficiency shown by 10-in. Multiclone tubes led to building a separator using 18 of them. Problem of removing separated dust from 18 parallel tubes was first attacked by grouping into two 9-tube banks with a trough and ash-removal screw under each. This scheme was used in third 250-hr test with enlightening but discouraging results.

Analysis of dust samples at turbine inlet showed a consist closely resembling that at separator inlet. Unit was checked for leakage and welded tight. Since single-tube tests revealed markedly better efficiency at 1500 cfm than at 1000, number of tubes was cut to 12. This effected slight improvement.

It became clear that recirculation through discharge troughs was at root of trouble. Thus a number of schemes for discharging dust separately were considered. After single-tube tests, troughs and screws of Houdry separator were replaced by "discharge pots" with individual blowdown lines leading to a common header. Thus modified, separator was put back into service and a number of successful tests were run.

Tube Test Program. During this period a separator testing stand was installed to check performance of commercial tubes at high temperatures and flows. Several flyash types are used in these tests, including ash caught by separator during Houdry-unit operation. Typical analyses, by Roller elutriator, for this ash, and the frequently used Detroit Edison ash, are:

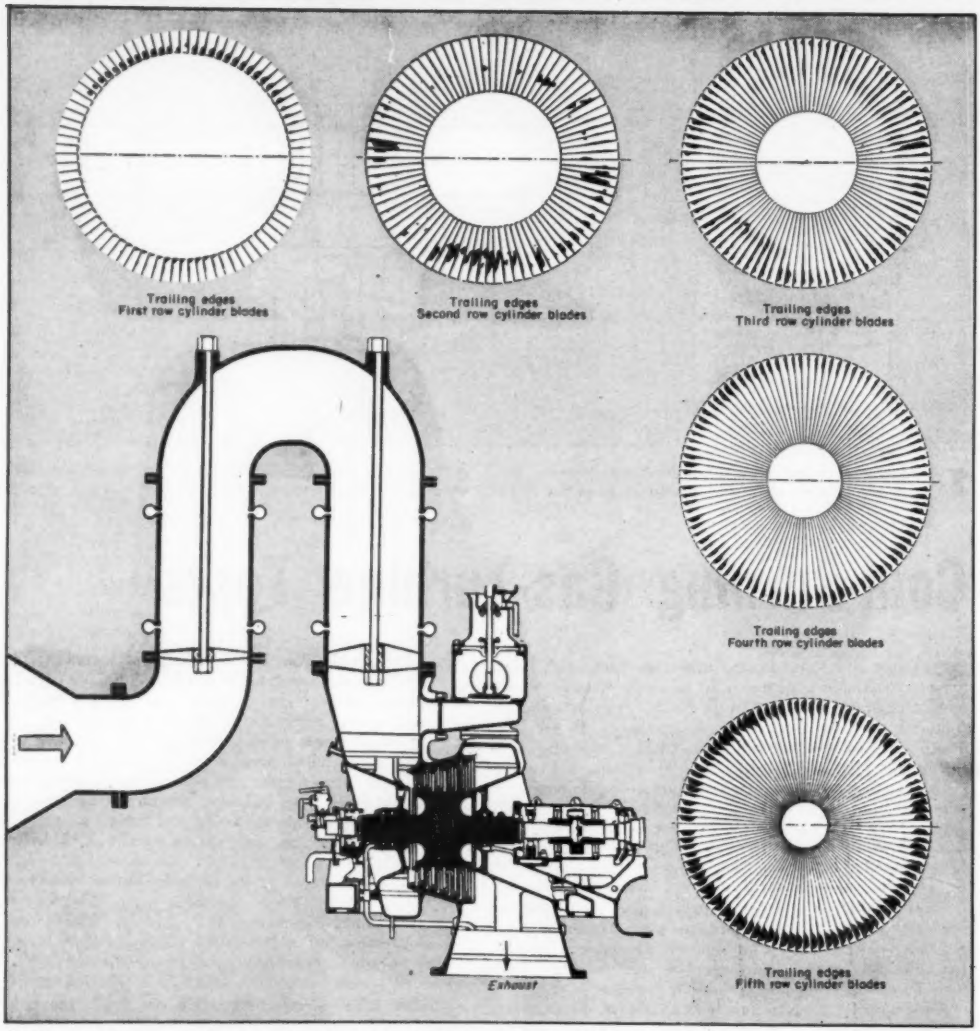
	Houdry ash	*Detroit Edison ash*
minus 10 micron	49.34%	20.4%
plus 10, minus 20 micron	30.0	22.9
plus 20, minus 40 micron	16.3	25.9
plus 40, minus 80 micron	4.0	22.0
plus 80 micron	0.36	8.8

Dunlab Tube. German literature on flyash separation showed good results for cylindrical tubes with iris diaphragm separator plates. As developed by LDC, tube uses blades in the "razor" plate to insure positive vigorous rotation of the dust-laden air entering lower discharge section. A tangential blowdown pipe provides continuous ash discharge. Dubbed the "Dunlab" tube, this device was tested to learn best dimensions.

Tube Performance. Fig. 1 shows performance of Dunlab tube of Fig. 2. Collection efficiency gains up to a flow of 1500 cfm, but only slightly above 1200. Efficiency also depends on blowdown but efficiency vs blowdown curve is quite flat above 1%. At 1500 cfm, blowdown of 15-20 cfm is adequate. Velocity of 60-90 fps in blowdown is more than enough to convey dust.

After best tube dimensions were found, Multiclone spinner vanes were extended to reduce exit angle from 45 to 30 deg. This increased pressure drop by about 30%, but raised

DIAGRAM SHOWS CYLINDER-BLADE EROSION PATTERNS AFTER 750 HR...



4 Section shows gooseneck inlet to Houdry turbine, believed to cause localized nature of blade erosion. Drawings made after third 250-hr test indicate areas of erosion on cylinder blading where main attack occurred. See photos, facing page

collector efficiency at 1500 cfm by 8 to 11 percentage points.

Modified Separator. After 33 hr of the fourth 250-hr test program had been run, the Houdry separator was modified by cutting off cone bottoms of the Multiclones and replacing with the Dunlab scheme of razor plates and a discharge section, Fig. 3. Individual blowdown lines were retained. Collection efficiency with combined louver and Dunlab separator appears near 90% with only about 10% of plus-10-micron dust at turbine inlet.

Blade Erosion. Inspection at end of first 250 hr revealed some erosion, mostly in cylinder blading. There was evidence blades had been hit by some large fragments of hard, dense ash. First-row cylinder blading was eroded badly near lashing wire, about one in. from blade tip. Bends in inlet gooseneck, Fig 4, and sharp change of direction at first-stage entrance apparently concentrated ash causing localized erosion.

After first 500 hr, first two cylinder rows and first rotor row were replaced. Lashing wires were omitted from first cylinder row. At this time separator was changed (see above).

Third Run. During the following 250-hr test (the third) severe erosion resulted from coarse ash getting through to turbine. It was still limited primarily to cylinder blades, although there was some thinning and sharpening of rotor-blade tips. First cylinder row showed same localized patterns.

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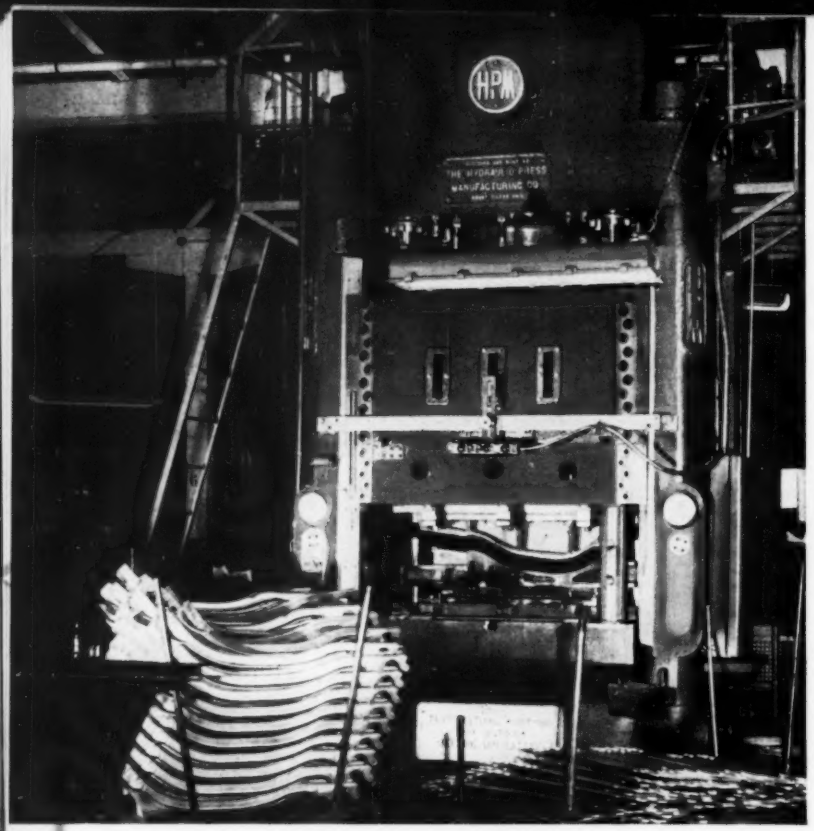

What's YOUR problem?

D. G. Cripps, of Standard Oil's Grand Rapids, Michigan, office, is the Standard Oil lubrication specialist who recommended STANOIL for use in the hydraulic press shown at the left.

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The big 400-ton hydraulic press shown above is used to stamp out parts for farm machinery in a big midwest plant.

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Oil capacity of the system is approximately 9 barrels; only 2 barrels make-up per year has been required. The oil in this system has never been changed. It has been centrifuged once to remove moisture which accumulated over three years' operation. Periodic tests of oil samples have shown that STANOIL has maintained its high lubricating quality. A recent analysis showed no increase in viscosity of the oil, no change in color, and a neutralization number of only 0.13 mg. KOH/gm.

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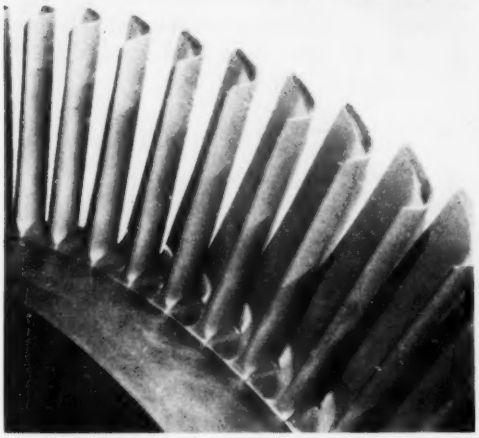
oil to give you the same clean, dependable service in your plant's hydraulic systems, speed reducers, head stock gears, auxiliary turbines, compressors, and electric motors. You can rely, too, on the expert, on-the-spot service of a Standard Oil lubrication specialist. How you can obtain his help, quickly and easily, is explained at the right.

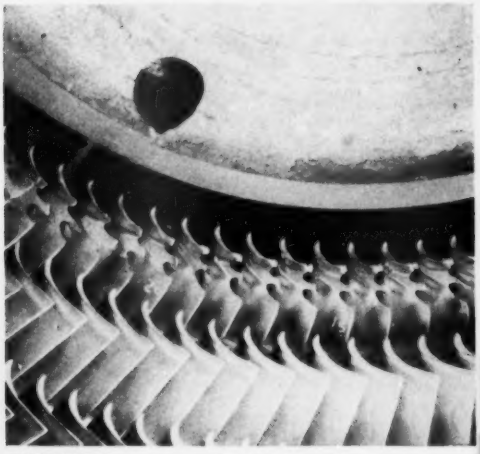
Standard Oil Company, 910 So. Michigan, Chicago 80, Illinois.

STANDARD **STANDARD OIL COMPANY (INDIANA)**

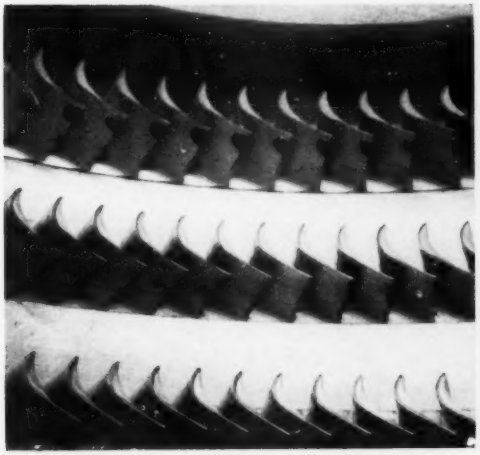
...AND PHOTOS SHOW TYPICAL CONDITIONS AT 500, 750, 1000 HR



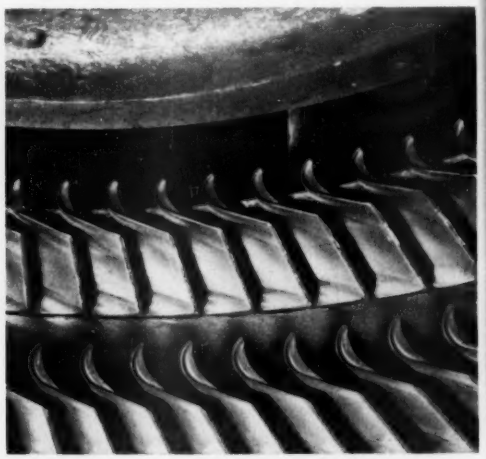
500 HR Rotor blading shows some erosion near the blade roots. First rotor row was replaced at this time



500 HR First two cylinder rows localized erosion of twin pattern apparently caused by lashings



750 HR Severity of coarse-ash attack shown by damage to first two cylinder rows replaced after 500 hr



1000 HR Cylinder blading, replaced after 750 hr, reveals little erosion during 250 hr with new separator

The second cylinder row displayed severe erosion in concave blade sections. Damage to third row was also relatively severe. Fig. 4 shows eroded areas on cylinder blading.

First three cylinder rows were again renewed to avoid risk of breakage and to give a sound basis for comparison with improved separator in fourth 250 hr. Lashing wire was restored to first row as vibration had been noted.

After 33 hr of the fourth 250-hr run, inspection showed no sign of erosion or deposits. The Dunlab tube having proved itself, separator was again altered and operation resumed on March 12, 1951. Daily inspections made through turbine exhaust line revealed, for the first time, a deposit was beginning to form. After 123 hr of the fourth 250-hr test, turbine was opened to see if deposits were significant or dangerous.

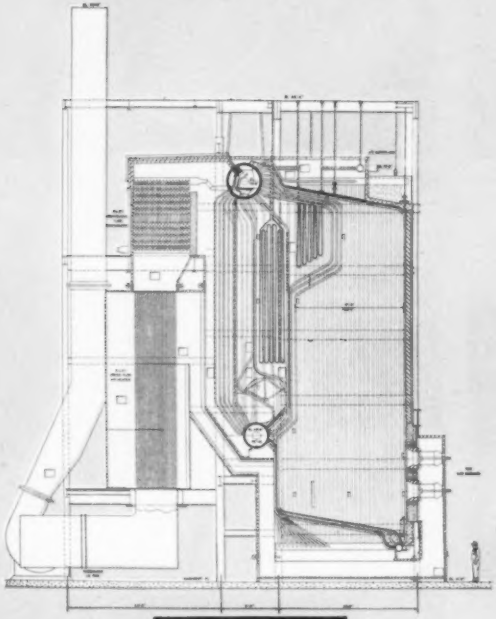
Deposits were found to be restricted to third, fourth and fifth rotor rows, with a slight amount on fourth and fifth cylinder rows. Deposits were all relatively soft, containing about 72% carbon. They were probably composed of fine coal dust passed through separator during startup. There is as yet no good explanation for their localized nature.

During fourth 250-hr run, erosion was insignificant (see photo above). It thus seems safe to conclude that removal of most of plus-20-micron particles and all but 10% of plus-10 eliminates rapid erosion experienced in third 250-hr test.

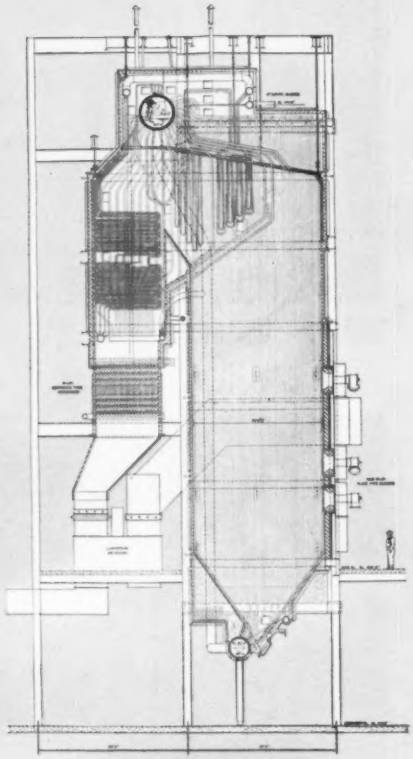
Typical RILEY High Pressure

Here are a few typical layouts of Riley high pressure, high temperature steam generating units. Riley units are establishing enviable records, not only for high efficiency and economy but for long continuous periods of trouble-free operation.

Because of unusual results from existing Riley installations Riley has attained a position among the leaders of the boiler industry. Many purchasers of steam generating and fuel burning equipment have found it pays to ask Riley for a proposal.



450,000 LBS./HR.
1450 LBS.–950°F.



400,000 LBS./HR.
1475 LBS.–955°F.

Dow Chemical Co., Freeport, Texas
The Texas division of Dow Chemical installed their first high pressure Riley units in 1942. They recently ordered four additional units. Ten 300,000 lbs./hr. Riley units are also installed.
Stone & Webster Engineering Co., Engineers

South Carolina Electric & Gas Co., Charleston, S. Carolina
This is the third Riley unit for South Carolina Electric and Gas Co. They installed their first Riley unit in 1947 and their second Riley unit in 1950.
Gilbert Associates, Engineers

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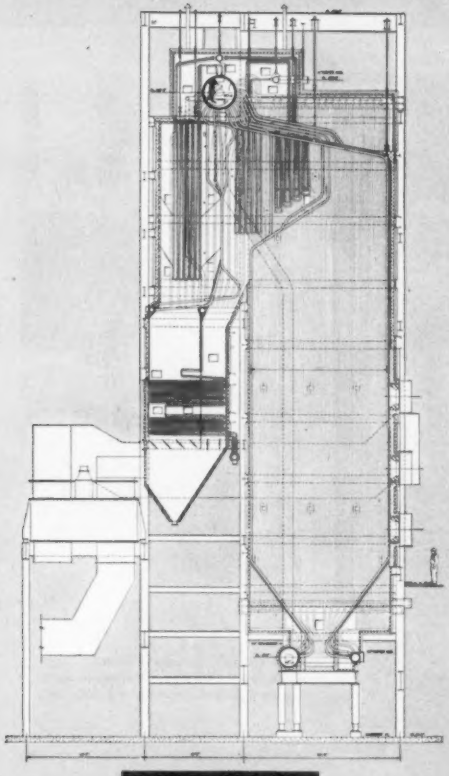
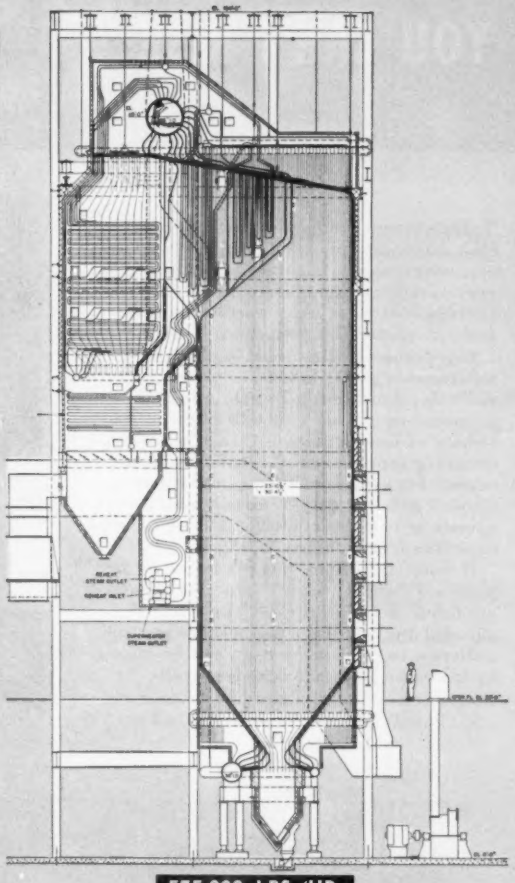


620,000 LBS./HR.
1500 LBS.–955°F.



575,000 LBS./HR.
1700 LBS. 1000°F.
1000°F.–REHEAT

Utah Power & Light Co., Unit No. 1, Salt Lake City, Utah
For the first unit at their New Jordan Station, Utah Power and Light Co. installed this 620,000 lbs./hr. Riley unit. In 1948 they installed their first Riley unit at their Orem Station.
Bechtel Corp., Engineers

Utah Power & Light Co., Unit No. 2, Salt Lake City, Utah
Utah Power and Light Co. selected this 575,000 lbs./hr. Riley reheat unit as the second unit at Jordan Station. Their subsidiary, Western Colorado Power, also uses a Riley unit at Montrose, Colorado.
Bechtel Corp., Engineers

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

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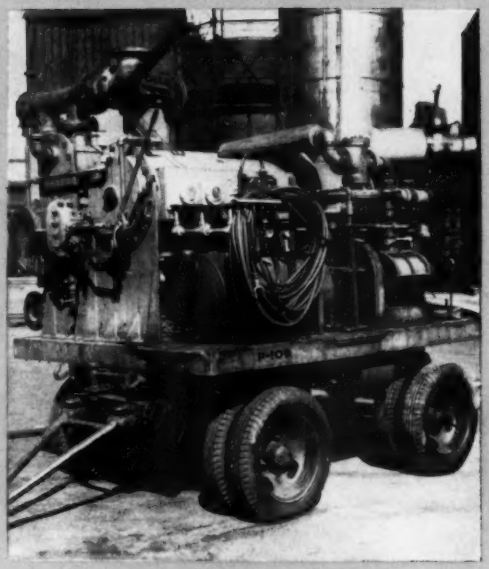
Today's urgent production demands can tolerate no unwarranted risk of interruption by explosions which might cause even small fires or other plant damage. Against such hazards, R-C Inert Gas Generators provide positive, economical protection.

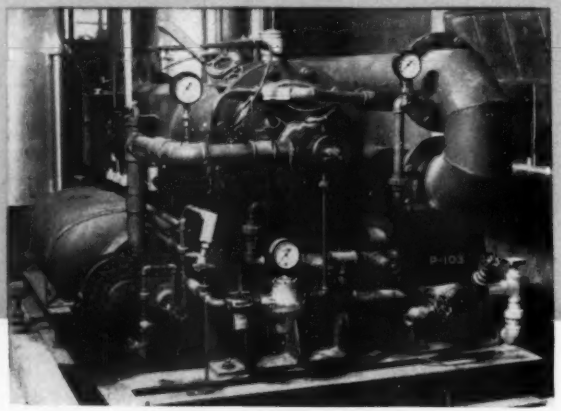
This protection is essential in plants where inflammable gases, liquids, explosive dusts and other dangerous materials are handled, processed or stored. Available either in stationary or mobile units, R-C Inert Gas Generators greatly reduce the risks from fires caused by explosions. They are compact, simple and sturdy in construction and operate at extremely low cost. Available in capacities from 1,000 to 35,000 cfh.

If your operations involve materials or processes which might cause explosion-produced fires, investigate the protection afforded by R-C Inert Gas Generators. Installation costs in many cases can be offset by insurance savings. Ask us for details.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Powell Avenue, Connersville, Indiana.



Portable R-C Inert Gas Generator used for purging operations and stand-by protection in large gas-producing plant. Capacity 15,000 cfh.



Installation of three R-C Inert Gas Generators similar to this one helped one large plant save $6,000 per month insurance premiums, as well as substantially reduce danger of production losses caused by explosion or fires. Capacity of each unit, 6,000 cfh.

ROOTS-CONNERSVILLE
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PLANT OPERATION and MAINTENANCE

SECTION OF POWER COMBINED WITH OPERATING ENGINEER

I've had my say plenty of times on this page, so now I'm going to let you readers speak up. In recent weeks, I've been flooded with your letters about the merger of POWER *and* OPERATING ENGINEER. *They came from every State in the Nation and quite a few from Canada. Here are comments selected at random from more than 500 letters—*

PHIL SWAIN

CANADA

"After reading April POWER with OE, I stand one-hundred percent with you on the merger. And I'm sure every other power man will do the same. Just what we need to know in maintaining and operating a plant is in the new POWER."

ARTHUR BELTON, *Engineer* *Montreal Coke & Mfg Co*
Montreal, Quebec

ALABAMA

"Excellent! I had to get both anyway in order to have complete coverage. But don't cut down on the practical stuff."

W M CLARY, *Engineer* *Alabama Prod Corp*
Birmingham

CALIFORNIA

"I renewed my subscription to OE because I think it's a swell mag, but would never renew to POWER. It carries too much paper. Takes all kinds of people to make this world, though, so don't feel bad."

L W WHARTON, *Oper Eng* *Laguna Honda Home*
San Francisco

KANSAS

"Most operating and maintenance men, like myself, have too little time to try to keep up on new ideas. We cannot read several magazines. Now, with the new POWER, it will make it much better for all. I am for it. Keep up the good work."

D S CHURCHILL, *Ch Eng* *Municipal Light Plant*
La Crosse

KENTUCKY

"It's okay. Just don't get OE lost in the deal. It was a real magazine for the practical engineer."

W M LUCAS, *Power Pl Supervisor* *Spencer Chem Co*
Henderson

EDITOR'S NOTE: *Don't worry about* OE *getting lost in the shuffle. It won't lose a thing—not its practical slant, its simple language, nor its Marmaduke*—PHIL SWAIN.

MAINE

"An excellent idea, and should have been done long before. POWER AND OE combined will give us readers a truly great magazine."

H W WOOD, *Safety Eng & Boil Insp* *Phoenix-London Group*
Lewiston

CONNECTICUT

"Very good. Power Handbook—excellent!"

H M KONITZ, *Plant Eng* *Sargent & Co*
New Haven

FLORIDA

"You people certainly are good to the engineers. Just think! OE plus POWER equals POWER²."

THOMAS BEER
Tampa

GEORGIA

"If you hold true to the line of what OPERATING ENGINEER has been doing, you will have made it."

BARNEY D RILEY, *Power Eng* *Brunswick Pulp & Paper Co*
Brunswick

IOWA

"I think it goes without saying—you really have a fine magazine. With merging of OE and POWER, we eat our cake and can have it too."

GORDON RANDALL, *Ch Eng* *Green Giant Co*
Vinton

MARYLAND

"I was kind of sore when I heard that OE was to be combined with POWER. But since I have had time to think about the change, I can see that it will be very helpful to all engineers. I think you have the best magazine of its kind in the U S. I also appreciate the Power Handbook. Keep up the good work."

D E SHACKEYARD
Baltimore

MASSACHUSETTS

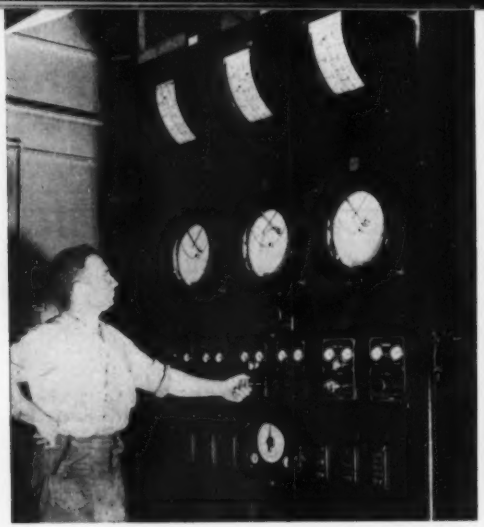
"The engineers will miss OE. It was one of the greatest magazines for the everyday engineer ever published. I hope the new POWER will be the same useful everyday help."

L S FRANKEL, *Operating Engineer* *Boston State Hosp*
Dorchester

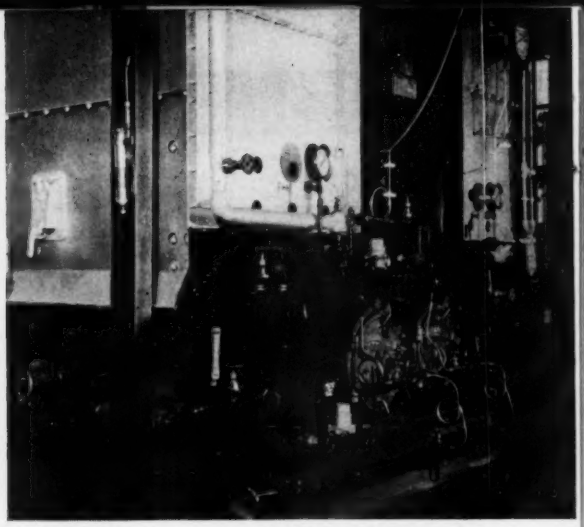
MICHIGAN

"It is great to pick up POWER and have two engineering publica-

(More states "chime in" on page 145)



1 METERS, CONTROLS. Meters, recorders and automatic combustion controls in boiler room continue to pay their way



2 OIL FIRING. Plant has three 35,000-lb-per-hr boilers. Two are oil fired like this unit; one coal fired by a stoker

These Steam-Plant Operating Methods May Help You Too

There are two ways to learn good plant operation—one is by experience, the other is by going backstage in other plants. For some solid tips on keeping equipment in top-notch condition, read this story of Curtiss-Wright steam-plant operation as told to Felix Giordano by Chief Alfred N Musgrave

► THE POWER PLANT of Curtiss-Wright Corp, in Caldwell, N. J., has the advantages of good design and good operation. High reliability, combined with economical operation under mighty tough conditions, was the prime consideration in designing this plant to supply process steam, heat and compressed air.

To what might be called design features, we operating men have made several contributions, which are explained in detail later on. Our additions help to eliminate waste, smooth out jumpy flow curves, reduce maintenance, hold efficiency high, make operations easier, and the plant a pleasanter place to work.

Equipment. Because steam and air loads jump around a lot, and because quick response to load variations is a must, flowmeters and automatic controls are installed on all primary equipment. These also serve to improve efficiency and reduce operating costs.

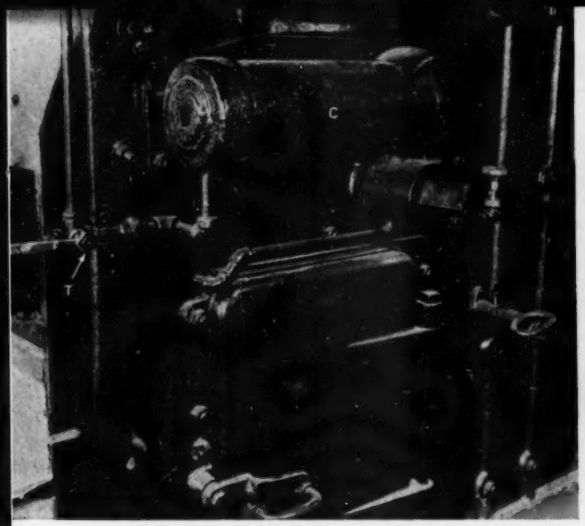
There are three boilers, each rated 35,000 lb per hr at 185 psi, saturated. Originally intended to burn oil, requirements of World War II forced us to convert two boilers to soft coal, even before their installation was completed. So we installed a coal silo, elevator, scale and a system of chutes, with a screw conveyer to distribute coal to the two single-retort underfeed stokers. Steam-jet ash-handling equipment along with an ash-storage silo were also installed.

Coal-Handling. Both the coal- and ash-handling systems are practically automatic. When coal in the stoker hoppers begins to run low, the operator presses a button that closes the circuit to the electric motor operating the screw conveyer. This starts the coal-supply cycle: silo to chute—to scale—to screw conveyer—to stoker hopper. A limit switch automatically opens the circuit to the screw-conveyer motor when coal reaches a predetermined level in the stoker hoppers.

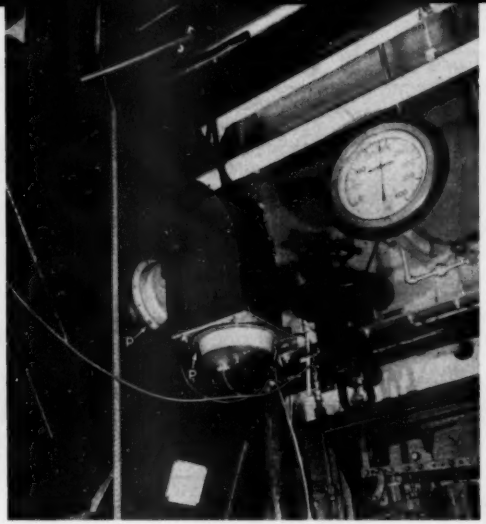
This system would have been adequate if the percentage of fines in the coal could have been kept within the limits the stoker manufacturer recommended. But often the coal was mostly fines and did not flow, or it arched over the limit switch in the hopper when it did run.

To remedy these conditions we installed vibrators on the chutes and on the stoker hoppers and another overflow cutout switch. The latter never failed to work, but this cannot be said of the vibrators, especially if the coal had a high moisture content in freezing weather.

Coal-Overflow Cutout. Fig. 4 shows how the second overflow cutout switch is installed. We cut a hole in the hopper side above the original pressure plate and switch P, and bolted on a square elbow. We closed the lower end of this elbow with a second pressure plate P_1 and connected its switch in series with



3 ASH-HANDLING CONVEYER. The stoker ash-dump grates once handled by steam are now worked by compressed air



4 STOKER HOPPER SWITCH. When coal arched over coal-conveyer limit switch, a second switch was installed at P_1

the one at *P*. When coal continues to flow into the stoker hopper because switch *P* fails to operate, coal falls into the 90-deg elbow. This develops enough pressure to operate switch P_1 to stop the motor.

This pressure plate is hinged at bottom of the elbow and only a small amount of coal falls on the plate before the conveyer stops. The operator need only place a bucket under the elbow and open the hinged door to clean out the coal. But he knows that the coal has bridged the hopper control, so he first breaks up this formation.

Ash Conveyer. We also had trouble with the ash conveyer, not because of any fault in it, but because of the way the stoker dump grates were operated. These grates are handled by a piston working in a cylinder *C*, Fig. 3, fixed to the boiler front. Originally the piston worked by steam, which exhausted to the ashpit. We found that line to the cylinder filled with condensate, and a lot of water mixed with the ashes.

We had no trouble in warm weather. In freezing weather wet ashes piled up in an elbow of the conveyer line, froze and clogged the line. We have plenty of compressed air, so decided to operate the piston with it. We used the same piping but removed the drain line to the ashpit and fitted a 3-way cock *T* in the air line ahead of the cylinder. Since we changed to air operation we've had no trouble with frozen ashes. With the old hookup, the steam cylinder drained to the ashpit making it hard to detect a steam leak through the control valve. Since the 3-way air cock discharges to atmosphere, the smallest leak through it is easily detected by the operator.

Oil Firing. The third boiler was equipped for oil firing during World War II. We ran it now and then so the oil-burning equipment could be checked and kept in good repair. After the war, one of the coal-burning boilers was changed to oil. Now one boiler is held in standby service to burn coal in emergencies. Oil temperature and pressure are maintained automatically at the burners. Of the three oil pumps, one is a direct-acting steam unit, one a motor-driven rotary and the third turbine driven. So oil can be delivered to the burners during almost any emergency.

Combustion air is supplied by motor-driven, forced- and induced-draft fans. An f-d and an i-d fan also have a steam-turbine drive, so the plant can operate during a power failure or when a major change is being made in the main substation. For a while we had an occasional smoke complaint from neighbors. Generally this was not the fault of the operating personnel, as normally they were not aware of the condition, which was of short duration. To end this trouble we installed smoke-indicating, recording and alarm devices. These have helped us stop the smoke nuisance and improve boiler and furnace efficiency.

Feedwater Heater. As originally put into operation the plant had an open feedwater heater, to which all condensate returns were piped directly. City makeup water was also piped to this heater and controlled by a float. After the plant had been running some time we decided to use cooling water from the compressed-air plant for makeup. This water, with the heat it picked up from the air compressors, was being wasted. Using it for makeup saved us money.

Condensate, mostly from exhaust steam in the heating system, collected in receiver tanks in different buildings and was pumped to the feedwater heater by motor-driven pumps, controlled by on-and-off float switches. Exhaust steam heated the feedwater.

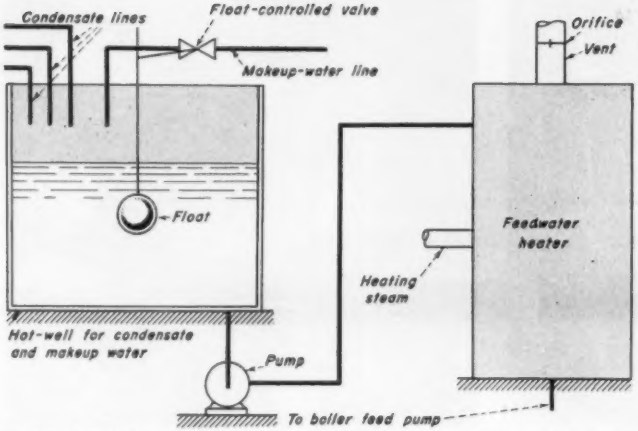
With this setup, when a condensate pump was running the heater got only condensate. But when condensate was not being pumped, cold water only came into the heater. Then the steam demand to heat this water was greater than the exhaust system could supply. As a result, feedwater temperature was all over the lot; pressure in the heater dropped so that air was entrained in the feedwater.

To correct this trouble, we installed a hotwell into which all condensate and makeup water is piped, Fig. 5. A float-controlled valve in the makeup line remains closed until the water level in the hotwell drops to about one-third-full. This level was selected so the hotwell could hold all condensate that came to it at any time. From the hotwell we pump the water to the feedwater heater.

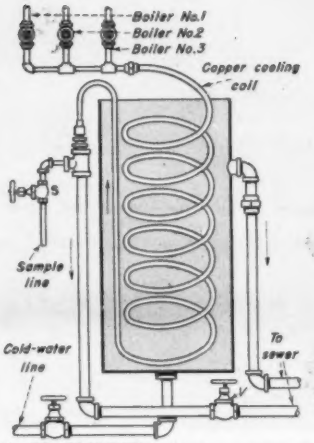
Température of water fed to the heater now varies gradually and within 20-F limits. Heating-steam demand is more constant and within the limits of the supply. We can hold a steady positive pressure in the heater at all times, thus avoiding air entrainment in the feedwater and wide variations in its temperature. A large part of the sediment that used to get into the feedwater heater now remains in the hotwell.

Feedwater Treatment. Boiler feedwater chemicals are dissolved in tanks.

(Continued on next page)



5 FEED HEATER. In original setup, all condensate and makeup feed went into heater. For satisfactory operation, hotwell tank was installed with float control



6 BOILER-WATER. Heat exchanger connects to boilers for water samples

From these tanks the chemical solutions are injected into the feedwater line by proportioning pumps.

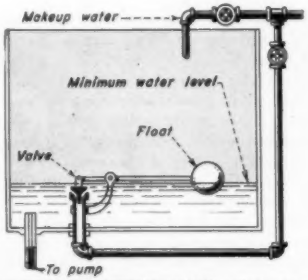
Normally we add a new batch of chemicals and refill the tanks at the same time each day. But now and then we get held up for an hour or two in filling the tanks. When this happens the tanks may run dry and the pumps get airbound.

While this isn't serious, it takes time to reprime the pumps just when other work may be pressing for attention. To get rid of this difficulty we installed in each open tank a float valve like that in the flush box on a toilet and connected it to the water line, as in Fig. 7.

Now, when the solution in the tank falls below a set level, the float drops and opens its valve. The valve admits enough water to the tank to keep air from being sucked into the pumps, and keeps them primed for immediate use when the tanks are filled with chemical solution for the day's internal treatment of the boilers.

Feedwater Tests. The watch engineer tests boiler water twice daily. He holds the percent of impurities within narrow limits as recommended by feedwater consultants. This has kept down scale formation and pitting, and we have had no tube trouble in our eight years' operation.

To sample the boiler water we use a homemade heat exchanger, Fig. 6, connected to all three boilers. This device gives a true sample of boiler water, and thus eliminates errors in concentration measurements. If water were drawn from the boiler at operating temperature, part of it would flash into steam, which would increase the concentration of impurities in the sample.



7 CHEMICAL-MIXING TANK. Float valve in tank keeps chemical pumps primed

Each of the three sampling lines, with its valve, connects to a header. From this header, water can be passed from any sampling line through a copper cooling coil in the tank. Cold water flows into the tank bottom and out near the top, while boiler water flows down through the coil and is cooled. Sample's temperature can be varied by controlling the flow rate through the cooling coil. From the overflow, cooling water goes to the sewer.

To take a sample of boiler water, we first open the cooling-water valve, making sure the sampling-line valve is closed. We then open valve *V* in the sample line leading to the sewer, and crack the valve in the line from the boiler from which the sample is to be taken.

After about two minutes we close valve *V* in the sample line to the sewer. Then we open sampling valve *S* long enough to drain off the water between this valve and the sampling-line tee. Afterwards we close this valve before taking the sample.

Meanwhile cold water flows through the cooling tank. After about five minutes, we open sampling valve and draw the sample. It is only slightly hotter than the cooling water. That's how we insure an accurate sample of boiler water. Then correct analysis gives a true picture of this water's condition.

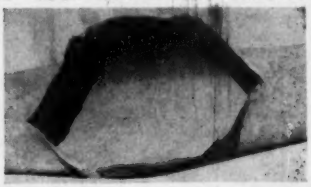
Meters, Recorders. We have described a few of the many things we have developed to meet the setup we found. No matter how well a plant is designed, conditions under which it has to operate account in a large measure for the troubles that may develop after it goes into service. Solution of these problems is a test of the operating engineer's ingenuity and resourcefulness.

Meters, recorders and automatic controls in the plant have paid off well and continue to do so. They give supervisors a means of knowing plant performance at all times. They also indicate changes in fuel quality and help the operators keep efficiency up and trouble down. If trouble does develop, meters help spot it as with the feedwater heater, originally installed.

Each shift keeps a log on which are recorded readings of flowmeters, temperature recorders, thermometers and other meters taken at regular intervals. Chief Engineer Albert N Musgrave uses these logs for his own information in supervising plant operations and for making his reports to management. In this way the chief engineer and, through him, management know at all times not only operating costs but also factors that make them run high, low or right.

BENT TUBES in Stirling boiler were caused by low water when José took to the road after tube let go. He didn't even stick around to stop stokers or feed more water

RUPTURED TUBE in first row let go from low water. Then all water flashed out



PLUGGED-SOLID tube in second row is hard to believe—but take a good look

Does Unskilled Help Save Money?

The boss saved wages. Then one day the boiler got plugged and he had an expensive shutdown. Bill Jones, boiler inspector, sees these things happen

► Woosh!!—The night's stillness was shattered by the roar of escaping steam. The mountains echoed the roar back and forth. "What's that!" asked the inhabitants of the little mining town as they ran out into the streets.

Even José the fireman, didn't know what had happened, or what to do. In fact, he didn't stick around long enough to find out. He was making tracks down the road—but fast.

Just a few minutes before, as the soft lights from his furnace fires danced on the boiler room wall, José had been counting the minutes until his relief came to take over.

After the first roar, he got out of that boiler room and didn't even shut off the power to the stoker motors. He didn't stop to see if water was going into the boiler. So water flashed into steam and the level dropped until the boiler was dry. Then the tubes began to sag and twist.

How It All Started. What once had been a proud power plant, had been allowed to run down at the heels. Why? Blame it on the march of progress, if you want. Diesel locomotives had replaced the coal-eating steam engines that once raced so proudly over the rails. Natural gas was piped in and the demand for this mine's coal was at a low ebb. So business was bad.

The three 500-hp Stirlings still supplied steam for the two 750-kw turbines at 200 psi. Generators still supplied power to the town and neighboring mines. But gone were the skilled hands that had kept this once-proud plant shipshape. Now machinery was covered with coal dust, and steam leaks were everywhere.

No License Laws. To cut expenses, the regular trained personnel had been laid off. They had long since left this dying mining town. Untrained men like José were hired to operate the plant. But they were only "starters" and "stoppers." The one competent man was at his wit's end. He was limited on what he could spend to keep things up.

That, dear reader, is the reason José was on the fires that night. He also watched the turbines, and had instructions to call the boss if anything went wrong. Usually he was given a good watch so things would run on their own.

José was told what to do if this or that happened. He would nod his head, take over and then pray that everything kept running until he was relieved.

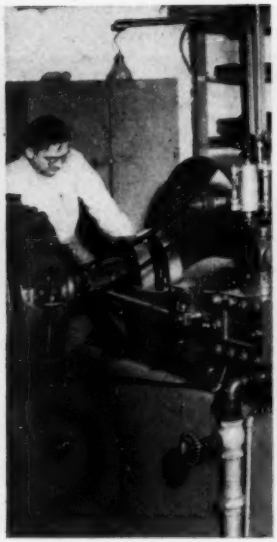
Price of untrained crew—one boiler. When the first-row, first-bank tube let go, it was José's signal to take off. You can see by the photo that this tube had a large hole. Because José didn't know what to do, the boiler soon flashed dry, and tubes began to twist and sag.

The first and second row tubes had to be replaced. While renewing these tubes, we found some tubes plugged solid. Hard to believe? Look at the picture.

Boilers in this plant had not been opened since last internal inspection. At that time scale was building up in tubes. So I ordered them turbined. Because the owner was penny wise and pound foolish, he didn't do that job. So he paid through the nose for this expensive repair and long shut down.

Moral. There are many ways to save money in plant operation. But *I've never seen money saved by cutting down on trained personnel, or by neglecting expensive power-plant equipment.*

AC GENERATION THEORY



. . AND STEAM ENGINES

. . PLUS DIESELS . .

More 'Power' at Dunwoody

Graduates qualify as assistant plant operators

Experienced men are given highly specialized training

Day and evening courses attract students from outside country

Practical shop and related theory supply know-how

► TECHNICAL know-how is America's number one weapon for security. And it takes all kinds of know-how to keep the wheels of this mighty nation rolling in war and peace.

Dunwoody Industrial Institute of Minneapolis, Minn., has been geared to train men in national emergencies for thirty-five years. Thousands of Army and Navy men were trained in World War I and again in World War II. And thousands of day and evening students have completed courses in between.

Training men for the maintenance and operation of the power services in this leading trade school attracts men from every state and even from foreign countries. So let's take a look at this unique institution.

History and Policy. This school is named after its founder, William Hood Dunwoody. He was a Minneapolis business man during the early years of this century. Mr Dunwoody believed that too little attention was given to training boys and men for the skilled trades. Then, as now in many communities, learning a trade was a hit-or-miss affair.

A new plant moved into town, hired the best workers it could get to run its equipment, and that was that. If an operator was good at doing one thing, chances are he stayed on that job. Often, the only way he could learn about other equipment in his field was by quitting and getting a new job elsewhere. That meant starting at the bottom all over again.

Mr Dunwoody's school opened in 1914. Since then 130,000 men and boys have completed day and evening courses.

Courses related to the power services have always been popular at Dunwoody. They include: air conditioning, electricity, general mechanics, machine shop, mechanical drafting, sheetmetal and welding.

Power. This day-school course qualifies the graduate for a job as assistant operator of a power plant, or as an engineer-fireman in an office building, hotel, hospital, etc, also for Minnesota licenses: Special, Fourth Class, Third Class, Second Class, First Class and Chief Engineers.

How long a student takes power course depends on three factors: his ability to grasp subject, his education and experience and what he wants to get out of the course.

Most students enroll for the full 18-month course. Men without previous experience need this full course. Experienced men may arrange for specialized training. A selection of units to satisfy students' needs is arranged.

. . AND PUMPS

. . PLUS DC MOTORS

. . AND GENERATOR UNITS

. . EQUALS TRAINED OPERATORS

Here Are Your Power Course Units

BOILER-ROOM PRACTICE I. Steam-generation fundamentals, boiler types, construction details, safety rules and precautions. Coal-firing vertical boilers.

BOILER-ROOM PRACTICE II. Operating high-pressure boilers. Combustion, flue-gas analysis, stack temperature and boiler efficiency, fuel storage and disposal. Operating costs.

DIESEL ENGINES I. Diesel principles. Starting, operating and testing with connected loads.

DIESEL ENGINES II. Testing with different fuels and loads. Cleaning and testing fuel pumps, filters, injectors. Exhaust temperatures and corrections in injector setting.

STEAM ENGINES I. Operating, adjusting and testing steam engines with indicators and Prony brakes. Governors, lubricators, and other engine accessories.

REFRIGERATION I. Basic refrigeration systems and controls. Disassembling and assembling refrigerators. Flaring, forming and soldering copper tubing.

REFRIGERATION IV. Commercial Service. Operating and overhauling commercial units used in ice-cream coolers, cold-storage plants. Unit coolers.

ELECTRICITY—BASIC I. Connecting meters in series and parallel. Principles of permanent magnets and electromagnets. Wiring lighting and signal circuits. Fundamental principles. Testing devices and methods. Splicing, soldering and taping.

LAB I—DC MEASUREMENTS. Testing dc series, parallel and combination circuits. Selecting, using and connecting voltmeters, ammeters, ohmmeters, wattmeters and bridges. Ohm's and other laws.

LAB II—AC MEASUREMENTS. AC circuit. Testing AC series parallel and combination circuits. Selection, use and connecnection of voltmeters, ammeters, wattmeters, frequency meters and power-factor meters.

DC I—DC Generators and Switchboards. Connecting, operating and testing dc generators in series and parallel. Connecting through generator and feeder panels. Testing under various loads.

AC III—Generators and Switchboards. Generators, exciters, switchboard panels. Synchronizing, regulating and protecting equipment. Operating a power plant.

MACHINE SHOP I. Bench, drill press, and lathe work. Laying out work, sharpening twist drills, grinding lathe-tools, drilling, filing and tapping.

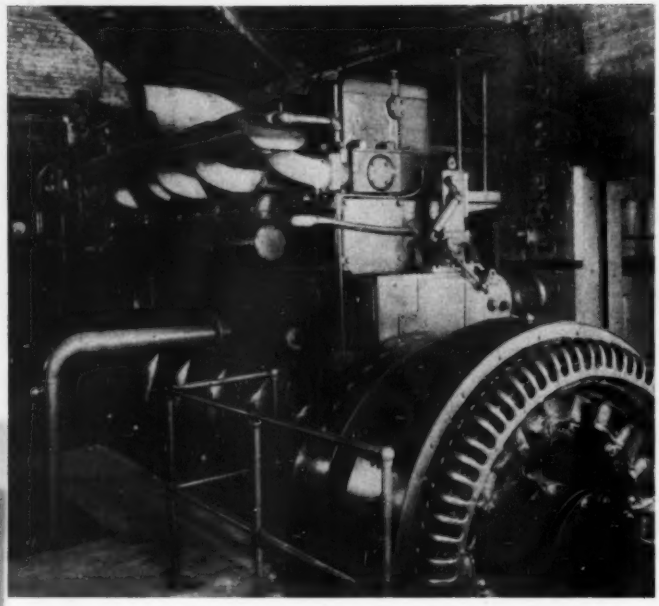
MACHINE SHOP II. Centering, boring and counter-boring. Knurling, making press fits. Shop math, blueprint reading, use of measuring tools and precision instruments.

GAS WELDING I. Safety precautions and welding steel with oxyacetylene torch. Welding light metal without filler rod, welding light and heavy metal in flat and flat fillet position. Cutting plates free hand.

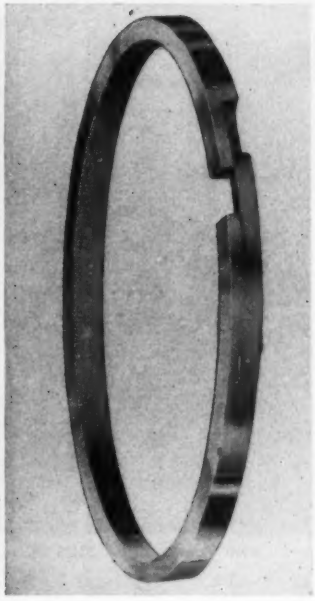
ARC WELDING I. Setting and operating arc-welding machine. Running stringer and weave beads in flat position. Welding plate steel in flat fillet position. Joints and type rods. Vertical welding with ac machine.

MAINTENANCE OF POWER EQUIPMENT I. Repairing engines, pumps, generators and other power equipment. Making new parts. Fitting bearings.

MAINTENANCE OF POWER EQUIPMENT I. Repairing engines, ing carbon tool steel. Heating, drawing, upsetting and twisting mild steel.



$$$ SAVED by this engine because compression is sealed with sealing-type rings and right oil rings scrape excess lube oil from cylinders before oil is burned



SEALING-TYPE RING keeps compression from leaking around in back of ring

Stop Wasting Oil!

► IN CHOOSING piston rings for your engine, consider the engine's "personality." Yes, though an engine isn't human it does develop a personality soon as it begins operating. Throughout engine's life, this changes, yet remains distinctly its own—different even from a brother engine of same type, size, make and age.

That's why you must select new rings for each engine carefully. Don't say, "I'll use the same brand, type and ring combinations the engine manufacturer used"—or "same rings I put in last time." Your engine has even changed since pistons were ringed last. So the engine now may need a different type, number, or combination of piston rings.

Engine Changes. Here are some changes that can take place: 1 Cylinder liners taper or become out-of-round. 2 Liners and rings wear rapidly. 3 Rings stick or break. 4 Liners score. 5 Engine uses more fuel and lube oil per unit power output than it did before. 6 Engine overheats.

Also consider climate, percentage of engine load and overload, types of fuel and lube oil used, maintenance schedules, etc.

How to Correct Faults. To correct these troubles, write down what's to be corrected. Send information to a reputable piston-ring firm. Don't just say 'my engine uses too much oil." Give enough information so ring people can analyze problem.

Tell type rings now in engine. Ring manufacturer works with ring problems so he's well qualified to help you.

Two general classes of piston rings are *compression* and *oil control*. Such type rings and combinations in each general class probably reach several hundred.

Compression Rings. Main function of these rings is to seal compression pressure. Then most pressure works pushing the piston.

When cylinders taper, ordinary open-joint rings won't seal compression. This leakage is especially bad in large medium-speed or slow-speed engines. Reason is compression blowby in these engines does more damage than in high-speed plants because of time element.

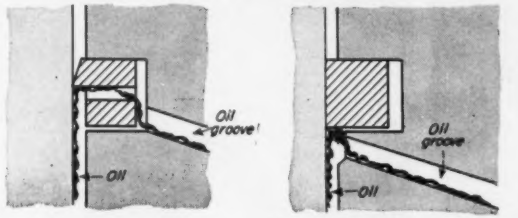
Keep blowby at a minimum to save fuel and to prevent harmful contamination of lube-oil film on cylinder walls. How can you stop blowby? Well, first step is to use sealing-type compression rings instead of plain (non-sealing) rings in out-of-round, worn or tapered cylinders. This ring does job because a tongue piece seals off gap (see photo).

As sealing ring expands when cylinder liner (face or ring) wears, the tongue continues to seal the widened gap against leakage. But when the plain ring expands, its open end gap *widens* and permits even more leakage.

When a ring wears .01 in. all around outside, the ring's gap opens about .06 in. Here are survey results of over 100 diesel operators. It showed that when a ring wears this much, engines with plain rings had blowby more than 26 times faster than with sealing rings.

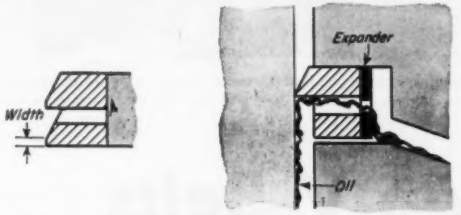
Clearance. Make clearance between compression ring and groove sides from .006 to .010 in. for two-cycle engines and from .003 to .008 in. for four-cycle

OIL RINGS AND PISTON DRAIN HOLES



1 Holes in piston remove oil scraped by ventilated ring

2 For plain ring, use holes on piston lip below the groove



3 Wider oil-scraper edge reduces ring's unit pressure

4 Sharp single scraper ring with steel expander is good

Does your engine burn up lube oil? How about compression? Does it blow past piston rings? Then let R W Hoyt, Chief Engineer of Double Seal Ring Co, show you right ring combination

depending on ring width and diameter. End gap should range from .005 to .007 in. per inch of cylinder diameter.

If rings or cylinder liners wear too fast, one cure is bronze-insert-type ring. But it's important that bronze insert be permanently bonded to prevent dislodging under operating heat.

Bronze has a high anti-friction value and will help rings over temporary periods of borderline lubrication.

Oil Control Rings. Here are a few things that affect oil rings controlling lube oil properly: (1) Number of oil rings per piston, (2) type of oil rings, (3) oil drain holes in piston-ring grooves or on lip below grooves, Fig 1 and 2, (4) free gap of oil ring, (5) width of scraping edge, Fig. 3, (6) use of steel expanders behind oil rings, Fig. 4.

The above items are important for cutting down oil consumption. But beware, there's always danger of starving engine for lube oil if you don't know what you're doing.

I've seen oil-ring change reduce lube oil from 25 gal per 20,000 hp hours to one gallon. I don't say we recommend 20,000 hp hours per gallon of oil, for your engine. Your engine may need more. I do know it's safe to cut down to this figure for some engines.

Oil ring's free gap is important. It controls unit pressure per square inch against cylinder. Free gap is opening between two ring ends when ring is out of cylinder.

Free gap is varied by different methods of manufacture. For oil rings, gap usually is about ten per cent of diameter. But it can be increased if drastic control is desired. The more free gap, the more ring tension.

Reducing oil ring's scraping-edge width is another way to increase unit pressure. Narrower edge reduces ring area in contact with cylinder wall. Then if ring tension remains same, the psi against cylinder wall is greater than before

A feature of oil control sometimes overlooked in four-cycle engines, and in compressors, is stopping oil-vapor escape. This vapor floats upward and passes through compression-ring gaps, then out with cylinder exhaust gases.

Vapor leakage can be stopped with a sealing type oil ring in top oil-ring groove. Like sealing-type compression ring, the sealing-type oil ring has a tongue piece to seal gap. Expanders behind oil rings impart additional unit pressure. But expanders can't be used if groove depth is too shallow.

Never reduce ring's radial thickness to make room for expander. Thinner ring is weaker, so expanders effect is removed.

Most drastic oil-control ring I know is a single-scraper ventilated oil ring with a knife sharp scraping edge and excess free gap. It's used with a crimped-type ventilated inner expander. This type ring wears faster because of its high unit pressure against cylinder wall. But it does excellent job of scraping oil and controlling consumption, Fig. 3.

Hold oil ring end gap to a minimum. Make gap between oil-ring ends when ring's in cylinder between .003 and .004 in. per inch of cylinder diameter. Make clearance between ring and groove sides about .003 in. This can be slightly more if ring width is greater than average.

Oil Problem. On a piston of five ring grooves, assume bottom groove is drilled with drain holes in groove. Also that piston has four plain compression rings with angle-cut-joints. Also one double-scraper ventilated oil ring with angle-cut joint.

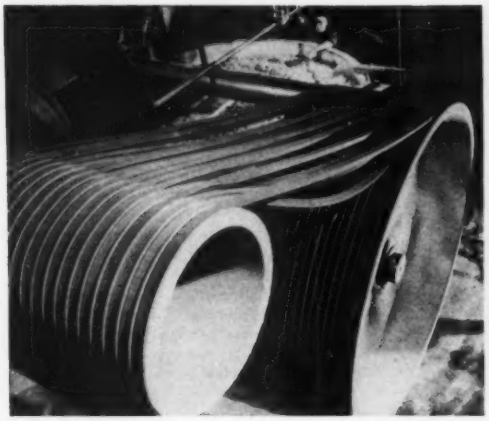
After operating engine for a while, lube-oil consumption jumps up. That means more oil rings needed on piston. But they can't be safely placed there. Too much compression will blow by if one or more oil rings replace plain compression rings.

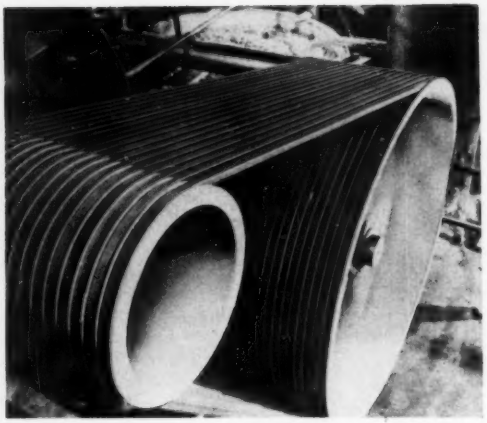
Best solution is to replace top two plain compression rings with gap-sealing compression rings. Then replace next two plain compression rings with oil rings. This will give oil control desired.

And it's been proved that two sealing-type compression rings seal better than four open-joint compression rings.

Selecting Right Rings. Here are factors that decide choice of engine piston rings: (1) Engine type, size and design specifications; (2) current operating and service conditions; (3) maintenance changes in engine (cylinder reboring, etc.); (4) all symptons of inefficient operation and trouble.

Most important thing to remember is that your engine changes daily. Your engine's "personality" now is different from a few-thousand operation hours ago. These changes mean engine needing new rings may need a *different* ring setup than last time. With fuel and lube oil prices climbing, use right rings.





DRIVE ON THE LEFT with its sagging belts may operate with little trouble but putting correct tension on belts, as at right, by adjusting center distance between sheaves, will materially increase belt life besides improving the looks of the drive

How to Keep V-Belts On the Job

By C J BUSACCA and F H RUMBLE
Texrope Department, Allis-Chalmers Mfg Co

Twenty-five how-to hints on installing and maintaining V-belts to insure long trouble-free service. If you are having trouble with these drives you'll probably find the cure right here

► PICKING THE RIGHT V-belt is only half the job of getting good service from it. V-belts have to be properly installed and maintained. Here is how this part of the job is done.

Belt Alignment. Align the driving and driven shafts so that they are parallel and belts are at right angles to them. Misalignment increases belt wear.

After a V-belt drive is aligned, put belts on the sheave loosely. Do not pry belts over groove edges as this may damage the cords in the belt and reduce its life. Next, back motor away from the driven machine to put light tension in the belts and turn the drive several times by hand. Then, back motor off until all belts appear snug.

Run the motor for a few minutes to seat the belts in the grooves. Stop the motor and back off again until all belts are tight and have proper tension.

Belt Tension. Place motor rails on their foundation so that the motor is near the rail's forward ends when belts are first placed on their sheaves. Then you can use nearly all the rail takeup to adjust belt tension.

Belts under proper tension are tight and have an alive springiness when hit by the hand. With a tachometer check driven-shaft and motor speed under full load. If there is an indication of slip, increase belt tension until slip stops by moving the motor back on its base.

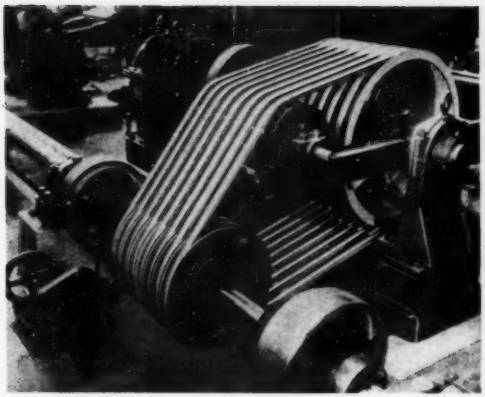
It is wise to check driven-shaft and motor speeds again in a few days. If no slip is evident, initial belt stretch has been taken up. Check belt tension at regular intervals to get best service and longest belt life.

When V-belts must be replaced, install a complete set of new ones. Do not mix old and new belts. If this is done the new unstretched belts, which have a shorter pitch length, will take more than their share of the load.

Matched Belts. All V-belt manufacturers mark their belts with similar inspection numbering systems. Knowing one system makes it possible to use the systems of other manufacturers. When a belt has the exact pitch length for which it was designed it is stamped with the number 50. Belts that are short 0.1 in. are marked 49, 0.2 in. short 48, etc. Similarly, belts longer than nominal pitch length are marked with a number higher than 50. A belt 0.5 in. longer than nominal would be marked 55.

When matching a set of belts, they need not all have the same inspection number except when they are less than 100 in. long. It has been found that long belts with different inspection numbers will work together when given proper tension. This is because the longer belts have greater stretch than shorter ones. Table I shows the limits of inspection numbers for matched belts according to overall belt length. A matched set of belts more than 501 in. long may have individual belt inspection numbers within a range of six consecutive numbers. For example, a set of six or more E540 belts could have inspection numbers of 46 to 51 or 50 to 55 inclusive.

Belt Sag. Relation between sag and belt length is often not clearly understood. On some drives a few belts may



ADJUSTABLE IDLER sheave may be used to keep correct tension in V-belt drives where shaft center distance is fixed

IF V-BELTS SLIP on their sheaves you can tell by checking the speed of the motor and driven machine with a tachometer

Table I—Inspection-Numbers Limits for Matched V-Belts According to Over-all Belt Length

Belt Catalog Numbers	Matching Limit
Up to 100	Use 2 consecutive inspection numbers
From 101 to 200	Limit is 2 consecutive inspection numbers
From 201 to 300	Limit is 3 consecutive inspection numbers
From 301 to 400	Limit is 4 consecutive inspection numbers
From 401 to 500	Limit is 5 consecutive inspection numbers
From 501 and up	Limit is 6 consecutive inspection numbers

Table II—Knowing Sheave Center Distance, Belt Sag Read Increase in Center Distance to Take Out Sag

Center Distance, Inches	Sag in Inches							
	½	1	2	3	4	5	6	8
20	0.037	0.130	0.513	1.08	—	—	—	—
30	0.025	0.095	0.343	0.78	1.51	—	—	—
40	0.010	0.074	0.240	0.59	1.03	1.61	—	—
50	0.008	0.028	0.20	0.44	0.83	1.27	1.86	—
75	0.004	0.018	0.17	0.30	0.60	0.87	1.25	2.12
100	—	0.025	0.054	0.12	0.40	0.66	0.94	1.79
200	—	—	0.03	0.06	0.21	0.37	0.42	0.70
300	—	—	—	0.035	0.16	0.29	0.35	0.63

sag noticeably while others are tight. Some engineers believe that tightening the sagging belts will overstress the tight ones. But this is not so. The difference in belt length between two consecutive inspection numbers in a matched set of belts is only 0.1 in. per 100 in., or 0.1%. When the shortest belt is stretched this small amount, it will in no way be harmed.

Not understanding the relation of sag to belt length leads to wrong ideas of belt length difference between matched V-belts of a drive. In Table II, a drive operating 100-in. centers, with a sag of 4 in., requires a take-up of less than 0.5 in. to remove the sag.

Check Sheaves. When V-belts need to be replaced, check alignment, condition of sheave groove walls and reason for belt failure. Here are several reasons for belt failure and their preventions:

1. If belts are run too loose, a so-called "crack the whip" action may occur causing a snub break. Cover-wear is usually seen on the snub-break belts showing that they were slipping before they broke.

2. Do not place guards around the drive that won't allow air to circulate about the belts. Belts will operate better in higher temperatures if air can circulate around them.

3. Do not let bolts extend inside the guard and contact the belts. They may dig into the belts and snap the cords.

4. Do not use V-belts in oily or greasy places that are not oil resistant or oil proof. Oil destroys ordinary rubber. Special neoprene (oil-resistant) rubber belts give much longer life.

5. Do not operate belts on sheaves smaller than those recommended. Constant bending over too small an arc will cause so-called "ply separation."

6. Be sure that abrasive dust does not wear the belt and shorten its life.

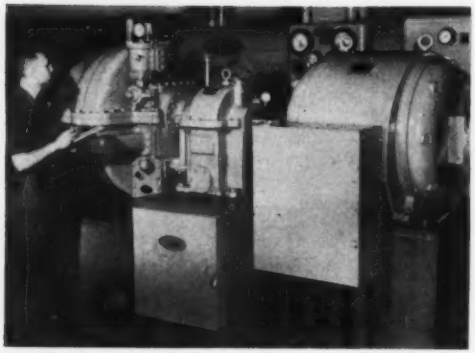
7. Before installing new belts, check sheave grooves. They may be roughed, rusted or pitted. As belts often run around the sheave more than 1,000 times per minute, sheave-groove condition seriously affects belt life. If sheaves are worn, replace them or turn the grooves true in a lathe to avoid frequent belt replacement.

8. Do not pry belts into the grooves or from one groove to the next. Provide for some belt take-up and adjustment of tension.

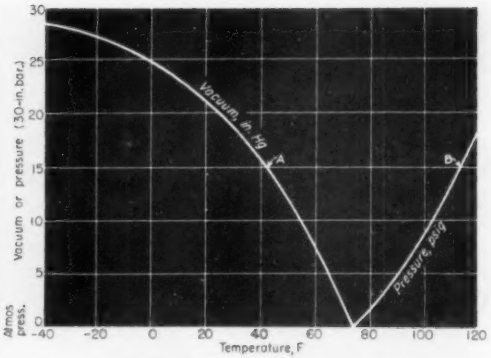
9. Do not operate belts in temperatures above 140 F unless there is good air circulation around them.

10. If extra sets of belts are stocked, keep them in a cool, dry place to prevent deterioration.

11. Belts are made for difficult heat, horsepower, oil and static conditions. If proper belts are not ordered at first for the drive, order the correct one when replacing the worn ones as needed.



CENTRIFUGAL COMPRESSORS give smooth trouble-free tonnage. To keep a check on refrigerant take log readings regularly



PRESSURE-TEMPERATURE chart for Freon-11. With this chart you can check refrigerant. Keep the chart in machine room

Charge Centrifugals Right...

. . . for best operation, most capacity. You won't go wrong if you know how refrigerant behaves, easiest ways to handle it. Sketches and text summarize charging, removing, reclaiming.

By **JAMES G MANNING**

Manager of Equipment Operation
Carrier Corporation

► YOUR CENTRIFUGAL compressor on cooling jobs may use one of several refrigerants—Freon-11, F-114, F-12 or others. But if you have the usual air-conditioning job you probably have F-11. It's used a little more often. So we'll talk about F-11 here; you can get dope on other refrigerants from builder.

Properties. Chart *above* gives pressure-temperature relation for F-11. It's mighty handy to have around the machine room because you can make many checks with it. Say with 15-in. mercury vacuum in condenser, liquid temperature is 42 F, point *A*; with 15 psig in condenser, gas temperature should be about 114 F, point *B*. Chart is for machine with no air in it.

F-11 boils at 74.8 F at 14.7 psia, is handled in open drums with little loss by evaporation. It's about 1.5 times as heavy as water, weighs about 12.5 lb per gal. When liquid, it dissolves oils and greases, also rubber. So packings with rubber in them shouldn't be used in F-11 machines. It can ruin them fast.

F-11 vapor is heavy—about 4.8 times as heavy as air. It drops to the floor and settles in low places when released. Vapor odor is sweet; large concentrations won't harm you but do cause dizziness and headache. It won't burn.

Charging. Sketches, *opposite page*, show how to charge your centrifugal with F-11. Never open drums when room temperature is above 74 F because you'll lose refrigerant or may cause personal injury. You can charge from an open drum when temperature is below 60 F but best way uses tight connection as in sketch.

F-11 drums have a special 2-in. plug on their side. It has a smaller ¾-in. plug inserted in it. Friction cap inside drum seals the ¾-in. opening. It's like a bottle cap and is pushed off by screwing a nipple with a closed valve on one end into the opening.

Handle F-11 drums carefully because they weigh over 200 lb. Chain fall on building beam or a properly supported rail does best job. Shake drum a little to find if it's empty after you've finished charging machine.

To add refrigerant to machine you can use chain fall and charge as liquid. Be careful not to freeze water in machine; this can damage tubes. You can also charge by drawing refrigerant gas into the machine from a drum resting on the floor. Cross wire on cooler sight glass, or other arrangement, shows when to charge. Always check refrigerant level when machine is shut down, not while it is running.

Removing Refrigerant. Sketches *opposite page* show how to remove F-11 from cooler. Inject air into machine with the purge-recovery unit until pressure is 5 psig. Connect tubing to charging connection and allow F-11 to blow into drum. You'll lose less of it if it's cold. Always leave space in drum for expansion when drum warms up. Follow builder's instructions when running purge unit.

To test machine for leaks you can build up an air pressure in it with purge unit. Since valving and machine arrangement vary we can't give definite steps for this job. But if you put an air test on machine without removing F-11 be sure to purge this air after test. Purge system takes it out fast.

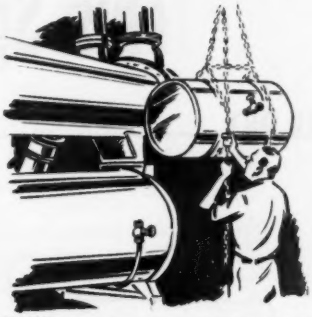
Reclaiming. When a refrigerant absorbs too much oil it must be rectified to remove the oil. Evaporating F-11 from drum into machine will do the job. Or F-11 can be returned to refrigerant manufacturer for oil removal.

You can remove oil from methylene chloride, also called Carrene No. 1, by the method shown on opposite page.

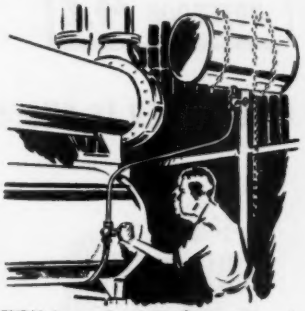
Either direct steam heating or a steam coil will do good job. Heat water to between 120 and 140 F. Don't allow water temperature to go any higher because refrigerant pressure will build up. Circulate water through machine to

Follow These Steps for Easy Charging

CONNECT closed valve to nipple. Remove drum plug. Screw nipple to push cap off

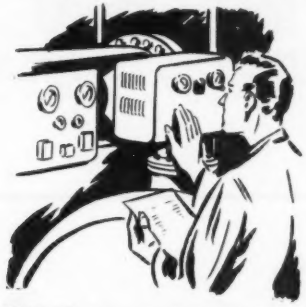


HOIST drum above cooler with chain fall or electric hoist. Be safe, drum is heavy



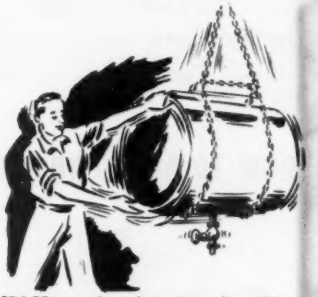
TURN drum valve down. Connect to cooler with copper tubing. Open both valves

Here's How to Remove Your Refrigerant



BUILD UP air pressure in the machine to about 5 psig with purge-recovery unit

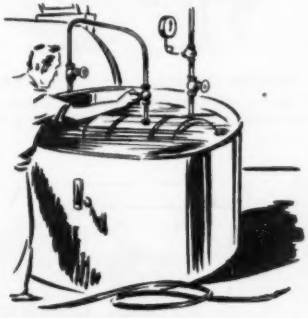
CONNECT charging valve to drum with copper tubing; let F-11 blow into the drum



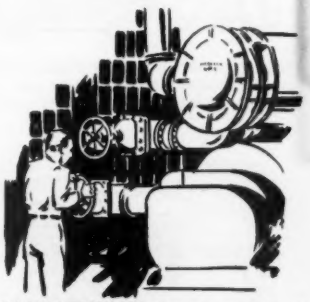
SPACE must be left in drum for refrigerant to expand. Shake drum to check space

How to Remove Oil from Carrene No. 1

TANK must be big enough to hold drum. Fill with water; heat to 120 F-140 F



PLACE DRUM in tank on sturdy supports. Connect drum to cooler charging valve



CIRCULATE WATER through machine to condense vapor from the Carrene drum

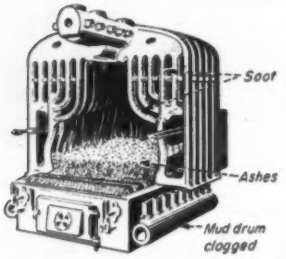
condense vapors from drum. This method removes almost all water and a good portion of the oil. Some oil may be carried over to machine but it isn't harmful, so you can neglect it.

No matter what refrigerant your machine uses always keep proper charge in it. With some types of coolers excess refrigerant may flood over into compressor. Too little refrigerant can cause low temperature and loss of machine capacity. Never charge above the top of the highest gage glass or allow charge to drop so low it doesn't show in lowest glass on the machine.

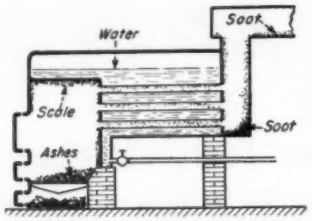
OPERATORS' NOTEBOOK 42

This Spring, Lay Up

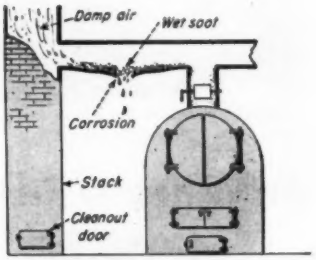
HOW BOILER IS KNOCKED OUT



CAST-IRON BOILER corrodes very badly if left dirty in summer. Soot absorbs moisture, forms corrosive sulfuric acid

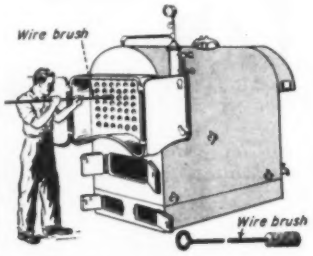


STEEL BOILER corrodes quickly in the summer if boiler is dirty and is not laid up properly for the idle period

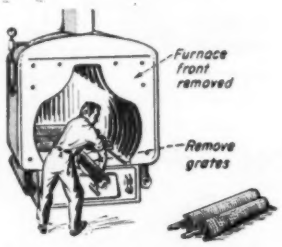


UPTAKES and breechings coated with soot corrode in summer months when there's not enough heat to keep moisture out

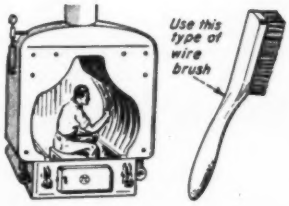
HOW TO ADD YEARS OF LIFE



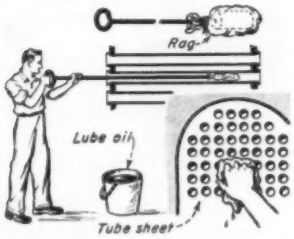
CLEAN boiler by removing ashes and punching tubes with wire brush until all heating surfaces are perfectly clean



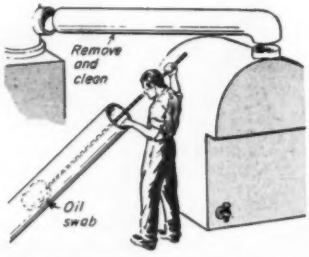
REMOVE GRATES if coal burner. Clean grafes with wire brush, renew burned or warped grates and swab with lube oil



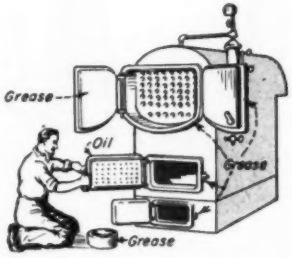
WIRE BRUSH all heating surfaces of every type boiler. Remove thoroughly all soot and scale from between sections



SWAB all tubes with used lube oil by placing a rag over brush. Then swab the tubesheet thoroughly with used lube oil



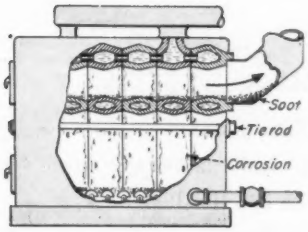
REMOVE SMOKE PIPES on smaller boilers. Clean soot, then oil swab inside. Stack in dry place until heating season



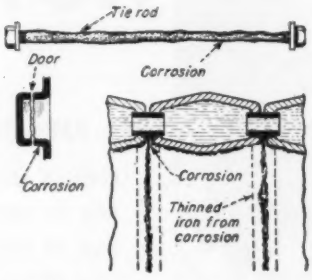
GREASE all machined surfaces on both steel and cast-iron boilers. This prevents air leakage past corroded parts

Heating Boilers Right

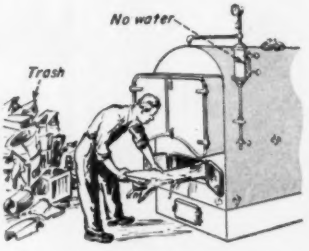
By **STEVE ELONKA,** *Associate Editor*



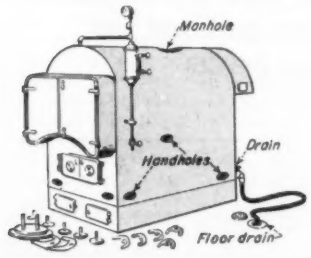
DAMP BOILER ROOM causes sweating in idle boiler that's filled with water. Then corrosion knocks out dirty boiler fast



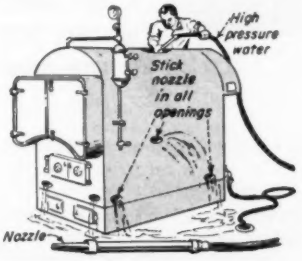
CAST-IRON BOILER is attacked by corrosion between sooty sections, at sooty tie-rods, and at machined surfaces of doors



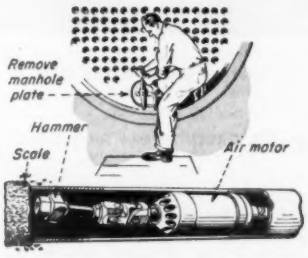
BURNING TRASH in idle boiler is bad. Many boilers are badly damaged from firing with low water or no water at all



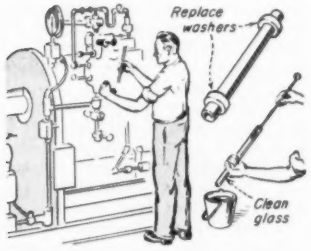
REMOVE MANHOLE and handhole plates on steel boilers (cast iron boilers don't have them) after draining off all water



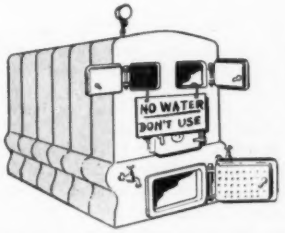
WASH INSIDE with highest pressure water you have soon as boiler is dumped. Then sediment is soft and washes out easily



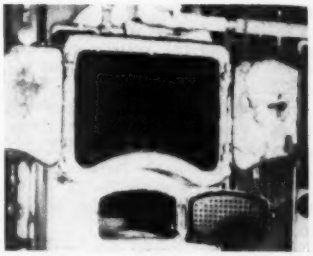
IF AFTER OPENING and washing large boiler, lime and mineral scale are on tubes outside, remove with this tube cleaner



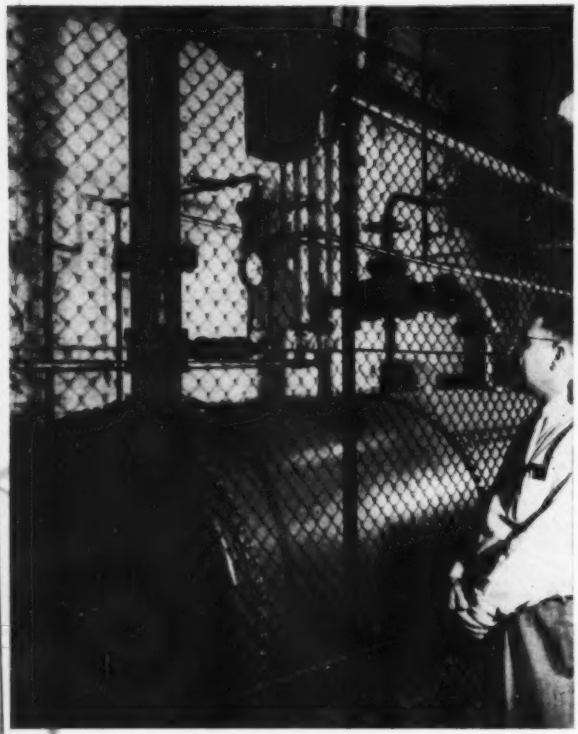
REMOVE gage glass and wash in household ammonia. Renew washers and make sure the gage glass lines are not plugged



HANG SIGN on boiler saying whether filled or dry. Operators Notebook 35 told how to lay up waterside WET or DRY



CLEANED, oiled and left open for air circulation, boiler rates long life. Cast-iron boiler full; steel boiler usually dry



SAFE TANK is clean inside and out, installed and piped right with safety devices and caged off from busy factory floor

Check Air Tanks NOW!

BILL DAVIS TELLS...

1. COMMON EXPLOSION CAUSES
2. HOW TO INSPECT TANKS INSIDE AND OUT
3. HOW TO SQUEEZE OUT MOISTURE
4. HOW TO HOOKUP TANK
5. HOW TO STOP LUBE-OIL HEADACHES
6. HOW FOUL AIR CAN FOUL UP PROCESS
7. WHAT ATTENTION COOLING WATER NEEDS
8. WHAT SAFETY RULES TO FOLLOW
9. WHY HOMEMADE TANKS ARE DANGEROUS
10. TANKS THAT COME UNDER ASME CODE
11. HOW PIPING GETS DAMAGED

By **BILL DAVIS**, *National Safety Council*

► AIR TANKS and receivers, the most common unfired pressure vessels, are relatively safe. However, they do explode unless they're properly designed for pressure and service used. They also explode when not installed right or not equipped with safety devices. So inspect them periodically and keep them in good condition.

Explosion Causes. Main causes for explosion are: (1) Vessel's metal corrodes. (2) Spontaneous combustion and explosion of lube-oil vapors in tank. (3) Vibration of tank or its connected piping. Vibration sets up fatigue stresses, eventually causing cracks. (4) Faulty or improperly installed safety devices. (5) Improper design or installation. (6) Water hammer in tank or piping.

There's no excuse for explosion caused by corrosion. If tank or receiver is inspected inside and out at set periods, corrosion can be spotted when it starts. Then arrest corrosion by cleaning and painting.

Inspection Opening. Air tanks should be equipped with inspection opening. According to ASME Code, a tank of over 36-in. diameter must have a manhole. Provide pipe plug openings on tanks of less than five cu ft. In small air tanks, remove intake and exhaust piping for inspecting interior.

Inspect small tanks inside and out for corrosion once every three months. When you first see corrosion spots, clean and dry thoroughly, coat with rust preventive paint. Spray paint on interior surfaces of smaller tanks.

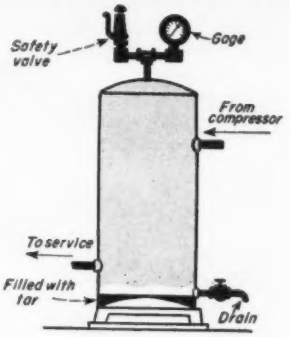
Moisture. Prevent external moisture on air tanks by locating tank in a well-ventilated, cool, dry location. Internal moisture can be prevented to some extent with separators on air line from compressor. Place a drain valve or cock at lowest point of air tank. Open valve daily, or oftener to remove water. This prevents a bad water-hammer hazard.

Concave-Convex Heads. Many smaller air tanks are made with a concave head at one end and a convex head at the other. It's poor practice to install these tanks in a vertical position with tank resting on the concave head. Reason is space between concave head and shell cannot be drained. If you can't set up such a tank any other way, fill concave head with tar or cement. Then place a drain line to blow all moisture from bottom, Fig. 1.

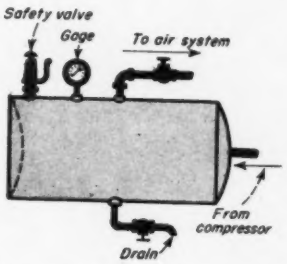
Mount this type tank in a horizontal plane with drain line on bottom side of shell, Fig. 2. If tank must be installed vertically, place convex head on bottom. Then use supporting stand. Tap drain into convex head, Fig. 3.

Lube-Oil Vapors. Explosions in air tanks and receivers are caused by lube-oil vapors igniting. Prevent such explosions by installing a separator. Also by good maintenance of air system.

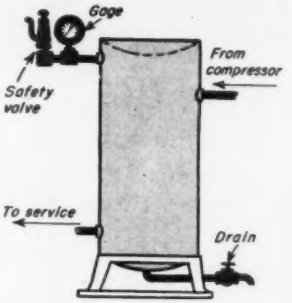
HERE ARE RIGHT WAYS TO INSTALL AIR RECEIVERS AND CONNECT SAFETY DEVICES



1 If tank must be set on concave end, tar the bottom to prevent corrosion



2 The right way to install a concave- or convex-head tank is horizontally



3 If tank must be vertical, give it a supporting stand on convex bottom

Air taken into compressed-air system through compressor's suction contains dirt and other impurities. That wears the compressor valves. Worn and faulty discharge valves tend to raise air temperature rapidly and progressively. That can cause spontaneous ignition of oil vapors.

Foul Air. Foul air is bad for most processes using compressed air. Locate compressors suction line, if possible, to take in clean, dry air. Also place a filter over suction line and activated carbon filters after the separator. Dismantle air compressor periodically and inspect all valves and piston rings. Replace faulty or badly worn valves and rings at once.

Cooling Water. Check cooling water several times daily for proper flowing. Compare water temperature at suction side with discharge side of cooling system. A sharp temperature rise shows that compressor jacket, or inter- or after-cooler is plugged up.

Clean scale and sludge from compressor water-cooling surfaces, intercooler and aftercooler. Best way is flush out at every inspection period. For more safety, install a fuse plug to relieve pressure caused by dangerously high temperature.

Lube Oil. Lube oil from compressor may carry into receiver or tank—often in the form of vapor. **Danger!** A spark, or a temperature rise of oil vapor above oil's flash point, will cause explosion.

To prevent explosion use best grade lube oil. Use only amount of oil recommended in manufacturer's instructions. Moisture and oil separator on tank's discharge line will greatly reduce amount of oil vapor entering tank.

Excessive oil and dirt, carried through air compressor, forms carbon scale in discharge pipe. As this carbon scale becomes dislodged and carried into tank, it may cause sparks. Then sparks ignite oil vapors in tank. Clean discharge pipe thoroughly at every inspection.

Cleaning Tank. When cleaning air tank's inside surfaces with caustic solution, also clean connecting piping at every inspection period.

Safety. Take usual precautions to prevent accidents in cleaning air tank and its piping. Open all manholes and handholes. Ventilate tanks thoroughly by removing all pipe plugs. If your tank is large enough for a man to enter, first test for volatile gases, carbon monoxide, and lack of oxygen. One way is with a flame safety lamp.

Have man entering tank wear goggles, rubberized gloves, and rubber boots to protect against caustic solution.

Testing Tank. Hammer test your air receiver at every annual internal inspection. If practical, hydrostatically test to one and one half times the operating pressure. Then shell plate or head cracks not visible to eye show up by leaking.

Improper Design. Many accidents are caused by improper design of non-code air tanks and receivers. Low 15- to 25-psi air is used in many plants. If receivers for this low pressure are made from water tanks or other containers, look out. Chances are your tank will explode. **Remember!** All air tanks should be designed and made in accordance with the ASME Code for unfired pressure vessels.

Piping Damage. Damage to compressed-air piping from vibration and pulsation occurs in two places. On air-compressor discharge piping and in the air line from portable air tank. A portable air tank like those used for construction work may have a manifold with openings for several air lines, connected directly to tank. Occasionally, a hose reel for a long length of air hose may be mounted directly on the air tank.

Pulsation set up by air tools causes vibration stresses at connection between air hose or manifold and tank. Install a U bend or vibration-dampener coupling at these points.

Stay Alive. Check all safety devices, such as safety valves and compressor unloaders, daily on a compressed-air system. Try vent and drains daily. If a safety device doesn't work, repair it at once.

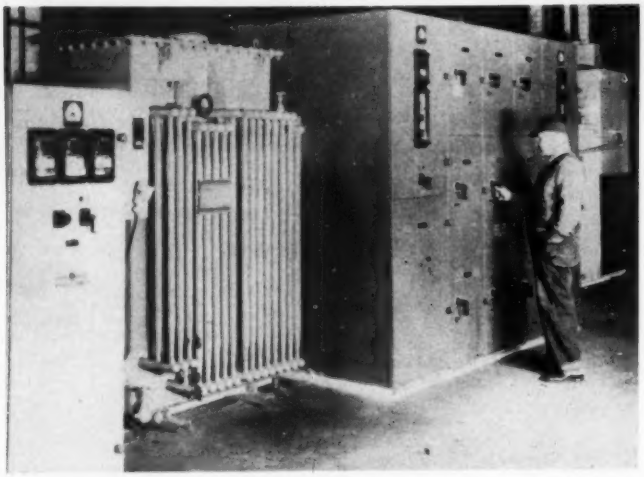
Is this too much work? Accidents happen for first time in plants every day. Follow my advice and you'll live a lot longer. And you'll be $$$ ahead.

Did you know . . .

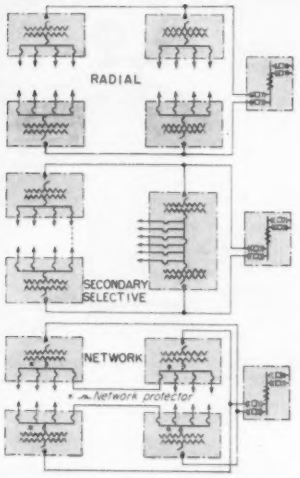
. . . that rubber gaskets don't work well on air compressors and air lines? Reason is that oil and heat soften the rubber in time. Use any asbestos-body sheet gasket between air cylinders and heads.

. . . that clearance between piston and compressor cylinder head will change unless you use same thickness gasket that the manufacturer used in new compressor? Install new gaskets, then pull bolts up tight after compressor runs a few days. Gasket will stay tight and keep from blowing out.

HOW LOAD-CENTER ELECTRICAL DISTRIBUTION FITS INTO PLANT EXPANSION PROGRAM

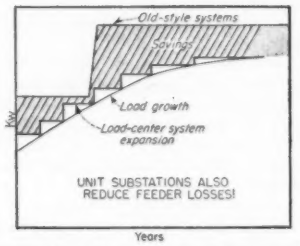


SAFETY AND ECONOMY are two basic reasons for trend toward unit substations. All live parts enclosed in grounded metal case. Non-inflammable transformers are used



COSTS VARY with your circuit setup. Radial hookup costs less; network more

Last April the Public Service Electric and Gas Co of New Jersey and GE engineers held a series of all-day forums with local industrial engineers. Aim was to tell how to get more for the power dollar. Here are pointers on electrical distribution, tips on lighting and electric heating



LOAD-CENTER method allows small additions to keep pace with load growth

New Loads? You'll Save

► COST OF PLANT electrical distribution system generally runs between 2 and 10 percent of the total building investment. And often not more than 1 to 5 percent of total plant cost including production machinery.

When considering changes in your distribution system look at the system as a whole. For instance, you can't very well consider transformers without the necessary switchgear. Transformer size helps determine how much kva interrupting ability the switchgear must have.

Always look at the system from the source to the load before selecting any additional equipment. Best way to get this over-all picture is to make a one-line diagram as shown above. Then you can see the whole system on one piece of paper.

Trends. Load-center-distribution system is the modern way to handle power distribution in an industrial plant. With this setup the high voltage is taken right to the load center. At that point voltage is stepped down through transformers incorporated into load-center unit substations.

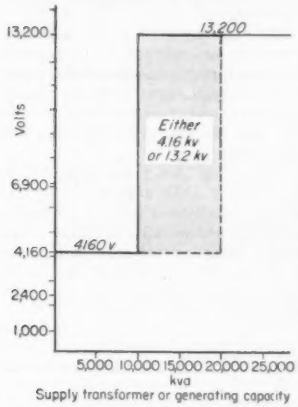
This trend toward the load-center idea is bound to continue. It is fundamentally sound. And it cost less compared to the old-style large single substation with piecemeal equipment. Average saving is about 20%. Then there's the safety angle to consider.

There will be an increasing amount of attention given to short-circuit protection. Circuit breakers must be able to successfully interrupt the maximum short-circuit current that may flow.

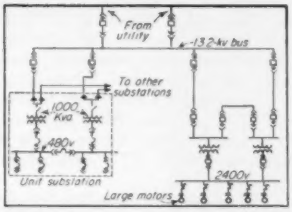
Talking of trends, more and more plants are adopting 480-v instead of 240-v systems; losses are 25 to 50 percent less. Some plants are actually modernized by changing from 240 to 480 v. On the other hand, 600-v systems are not generally being adopted for new plants. Big reason for the spurning of the 600-v class (even though it's less expensive) is the absence of 550-v equipment as a stock-item.

Primary voltage will continue toward 4160 v in the small and medium plants. In the larger plants (above 20,000-kva supply-transformer capacity) 13.2 kv is becoming the accepted voltage. High

HIGH PRIMARY VOLTAGE, UNIT SUBSTATIONS LOWER VOLT DROP

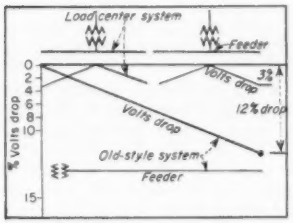


HIGH-VOLTAGE trend continues. Small plants are adopting 480 instead of 240 v

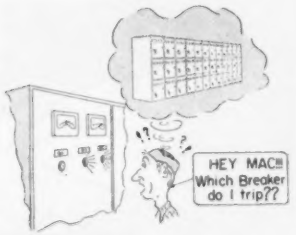


TYPICAL APPLICATION showing 2400 v fed to the large motors (over 200 hp)

BUS DUCT with plug-in feature. Used widely where machines are moved often



SHORT FEEDERS on secondary of unit substations keep voltage drop under 3%



IN UNGROUNDED systems operator trips breakers singly to find accidental ground

DON BEEMAN . . .

. . . stressed importance of unit substations at this session as outlined in article below. Don is Manager of Industrial Power Division at General Electric Co and is one of the recognized authorities in industrial distribution. He has spent over 16 years in the power-distribution-engineering field and was one of the country's early pioneers in development of load-center systems. Don fully appreciates problems facing operating men in nation's industrial plants

With Unit Substations!

primary voltage means lower cost, greater flexibility and greater margin for expansion. These voltages are being adopted instead of the 600- or 2400-v systems for medium plants and in place of 6900-v systems for the larger plants.

You're not overlooking the safety angle when swinging to higher voltages. Modern unit-substations, switchgear and cable enclose all live parts in metal. This metal housing is grounded.

Small Plants. Any plant of a few hundred kva or larger taking primary power from a utility can apply these principles. Sure there may be only one substation involved—but locate that one substation close to the center of load.

Of course plants that buy power directly at low secondary voltage do not brush shoulders with above voltage problems. But they do have the problem of providing a flexible distribution system. Plug-in bus duct, adequate interrupting rating of switchgear, and safety are just as important in the small as in the large plant.

Modernization. Time to modernize is when there is a plant addition or production-line change. For example, let's look at one plant where the primary voltage supplied by the utility was already 13.2 kv. The 13.2-kv metal-clad switchgear was less than 10 years old. Utilization voltage was 480. However the substations stepping down to 480 v were large, 5000 to 10,000 kva each, and were in generally poor condition. Area around the oil-filled transformers was congested; a real fire hazard.

System voltage drop was up to 20%. This factor alone caused many operating troubles. Some fluorescent lamps failed to light.

These substations could have been replaced with large modern unit substations at the same locations. But large substations are costly and inflexible. After looking the system over two things were obvious:

(1) There were many motors that could best be served at 2400 instead of 480 v.

(2) More small substations distributed around the plant would cost less than a few large substations. It would also mean better voltage. And several

thousand feet of old secondary cable could be sold for scrap. This was the plan adopted.

The existing primary switchgear was kept. New 480- and 2300-v load centers were installed.

This plan was adopted since it cost about 10% less than straight replacement of existing substations. Under the new setup voltage drop was held to a 2-percent maximum. And further expansion was simplified. By installing some 2400-v substations new motors rated over 200 hp were hooked in on 2400 rather than 480 v. The over-all change was made on a step-by-step basis, installing a few substations each year.

Grounding. There appears to be a definite trend toward grounding neutrals on all systems from 120 v to 287 kv. Many of the large aircraft manufacturers pushed grounding of 480-v power systems during the last war. Perhaps one reason was their heavy fluorescent-lighting load. It was found that by using 264-v fluorescent lighting ballasts rather than 120-v, there was a big copper saving. Power supply to lamps was 480 Y/277 v with neutral grounded.

There were three immediate benefits in grounding the neutral on these lighting systems: reduced maintenance, improved service reliability, greater safety.

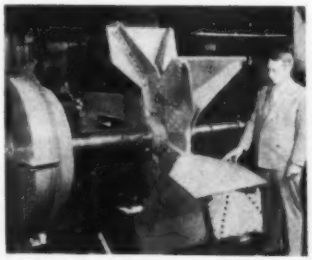
Let's see why the benefits. In an ungrounded neutral system the ground-indicator light spots an accidental ground. It will also tell what phase it's on. But it will not tell you where the ground fault is.

So the operator has to trip the circuit breakers, one at a time, to find which feeder or machine has grounded. And it often means tripping all the loads on that feeder singly to find the trouble. This is costly and takes the system out of service.

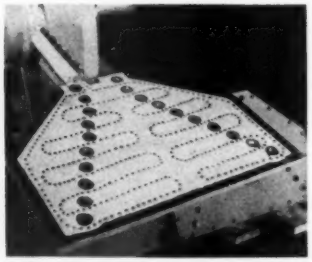
If the ground fault is left on an ungrounded neutral system, the small charging current can cause real trouble. This usually happens when the ground is the make-and-break variety. You build up a high charging voltage between line and ground.

In one case 1200 v was measured to ground on a 480-v ungrounded neutral system. This system had an accidental restriking ground on one phase. High voltage hung on for over two hours. In the meantime it burned out over 50 plant motors. Grounded neutral holds down these surge voltages.

Electric Heating of Fan Blades Corrects Unbalance



BLOWER FAN for drawing hot gases became unbalanced by oil sludge on blades



TUBULAR HEATER on each blade along dot pattern prevented sludge formation

► HERE'S A HEATING application that's off the beaten path. Oil sludge forming on fan blading was licked by installing tubular heaters on underside of each blade.

Where the blade is a bolted 2-piece affair, simply unbolt and lay the heater in between. Then refasten the blade sections. However if the blade cannot be taken apart it's best to shape the heater and then hold it in place with a sheet-metal cover.

Collector rings and brushes may be used to bring the electrical supply to the heaters.—E H RUSCH, *GE Co.*

GOOD **SHOP LIGHTING BUT ➡**

Basic problem in shop lighting is to get right light on work area without glare or discomfort to machine operator. Bright background eases seeing task by reducing contrast. Above lighting job gives good light on work with the background brightness up to par with light paints. Note arrangement of fixtures for even over-all lighting. Weak point is contrast from dark unlit ceiling

BEST **LIGHTS CEILING TOO!**

Today's goal calls for adequate lighting level, good reflection from walls, machines, and floor along with some light on ceiling. This is handled above by lighting fixture with slots in upper porton of reflector. Lighting unit also has center baffle to shield bare lamps; this means less annoying glare to lads working at benches. *E M Fahey and L T Johnson, Public Service Elec and Gas Co*

Make Banding a Cinch

By **R H WILSEY,** *Master Mechanic*
Foley Brothers Inc, Colstrip, Montana

► DECEMBER 1950 issue of OE, p 45, had an article on armature rebanding in an industrial plant. While the info in that article is fine for some repair shops, it may not work in the average maintenance department in an industrial plant. In the first place the method described requires taking the armature out and swinging it into a lathe or other driving source.

Simple Method. To reband an armature I need only a chain hoist and a pulley or two. Armature may be left in its own bearings, supported between centers in a lathe, or supported on horses so it can be turned by hand.

Start by anchoring one end of banding wire to a peg loosely driven between coils in an air duct or bolt hole in fan support. Put on about 3 free turns of wire. Put clips in place and add correct number of turns without tension. Finally add 3 more free turns. Cut banding wire off and run end through a snatch block or pulley. Then fasten to second peg as at other end.

Attach overhead chain block to pulley. Then turn the armature backwards until the banding wire starts to unwind from its true location. Pull the chain block up till there is tension in banding wire. Use a scale between pulley and chain hoist. Remember that this scale should read *double* the desired wire tension.

Hold right wire tension; for steel wire scale should read 1700 lbs for No. 8, 1200 for No. 10, 800 for No. 12 and 500 for No. 14. Roll armature by hand and guide banding wire into place. Stop when free turns start to go over pulley. Repeat procedure while turning the armature in other direction. I usually make 3 passes, starting with a low tension and winding up with desired amount.

After last turn of wire is in its place, take another turn to bring ending clips to top. At this point carefully solder about 6 in. of the band. Then cut both free turns. Fold back wire ends and solder entire band.

Easy Turning. Armature is easily turned any amount by hand in either direction. Wire tension tends to lift armature out of its bearings, reducing the turning friction. When turning is stopped there is no need to worry about back lash or slipping.

Often the coils on a newly rewound armature settle a little more into place when banding wires are put on. And quite often the first few turns are left loose.

Banding method just described permits taking up this looseness giving a snug, even band that will not shift in service. It also allows heavy, awkward and easily demaged armatures to be rebanded in place.

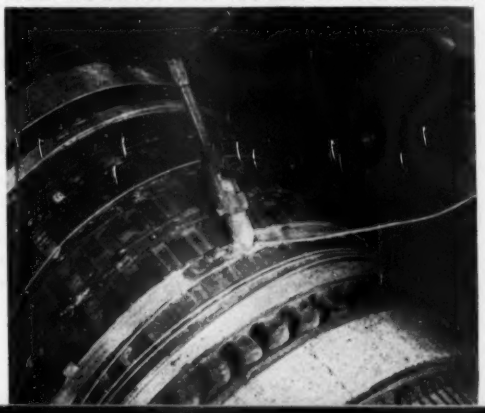
I also use this method to make sure that new coils of mill-type motors are firmly seated in the slots before banding. Rather than hammer on them and risk damaging insulation, I use strips of fiber or hard wood the size of the slot.

I place one of these strips over each coil and wind banding wire over them. Then I apply tension with the chain hoist so the banding wire forces the coils slowly into place. They go down straight and undamaged and seat firmly. The end banding wires are then applied as above. The temporary strips with their banding wire are removed and final bands applied.

APPLY BANDING WIRE without tension. One end of wire ties to wood plug; other around fan bolt. "Free" turns already laid

WHEN BOTH ENDS of wire are secured, band is ready for rolling. Chain hoist, with narrow groove sheave, holds correct tension

WITH TENSION ON, solder clips at starting point. Then release tension and cut free turns. Fold back wire ends and solder



PRACTICAL IDEAS...*here's the trading post for your*

MEASURES WATER WITH A BUCKET

IF YOU WANT to know the amount of water flowing out of a pipe it can be found with a bucket or an empty oil drum if the quantity is not too large. When you do not have a stop watch, time can be taken quite accurately on the second hand of an ordinary watch.

When the second hand reaches zero, put the bucket under the stream and let it stay there until full, as in the photo. Then read time again.

Say that it is a 5-gal bucket that fills in 20 sec. Then 5 gal divided by 20 sec multiplied by 60 sec equals gallons per minute, or $(5 \div 20) \times 60 = 15$ gpm. When flow is too great to be measured in a bucket a large container may be used, such as a 42-gal barrel or a 50-gal drum.

When in doubt of the size of the container, weigh it before and after filling it up. Say a bucket weighs 2 lb and after being filled in 25 sec it weighs 40.5 lb. The weight of water equals $40.5 - 2 = 38.5$ lb.

Flow in gallons per minute equals weight divided by time multiplied by $60 \div 8.33$. The latter is the number of sec in a min, divided by the weight of a gallon of water. Then gpm $= (38.5 \div 25) \times (60 \div 8.33) = 11.1$.

HARRY A HESS *Houston, Texas*

Dye and Ultra-violet Light Find Condenser Leaks

CONDENSER-TUBE leaks, particularly the small seeping ones, can be found easily with fluorescent dye and an ultra-violet light. Calcoid uranine is a good dye for the purpose, which becomes a bright yellow under the ultra-violet light. Both can be found at most laboratory supply houses.

Use one ounce of dye per 1000 gal of condenser capacity. Mix the dye with 4 or 5 gal of water and pour it into the condenser. If the condenser leaks badly, fill it in steps and check the covered portion of the tube sheet at each stage.

This prevents getting dye over the entire tube sheet from leaks in the top. For the same reason plug each leak when found. Check the high end of the tubes first. When checking condensers with packed tubes, put markers in those in which the packing leaks so that the packing may be tightened later after testing.

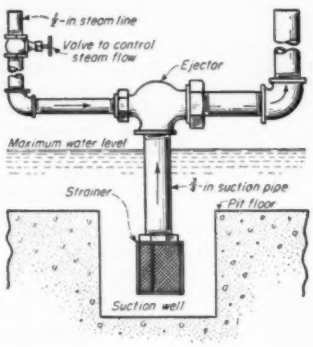
The yellow color of the dye stands out like a "sore thumb" under the light. This makes it easy to distinguish between a small leak and water standing in the tube.

A S GRIMES, JR. *Logan, W. Va.*

Where to Install Steam-Operated Ejectors

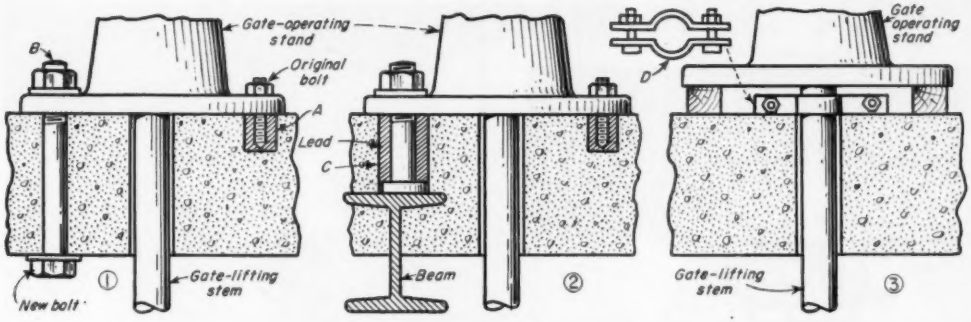
WE USE SEVERAL steam ejectors for taking water out of pump and skip-hoist pits. These ejectors are of different sizes, but are all same as hookup in the figure. Ejectors may be used for total suction lifts up to 20 ft and total heads of 70 ft, depending on steam pressure. But we find that they work best in low-suction lifts.

It takes more pipe to set ejectors close to the water surface, but it pays off in smoother and surer operation. Often when the suction lift is high and water is muddy or contains oil the ejector may lose its prime. When this happens a lot of steam can be lost before the steam valve is closed and ejector primed again. In a short time this steam loss may equal the extra cost of piping to set the ejector close to high-water level in the drain sump.



In the bottom of sumps we make a small pit in which to put the ejector intake. This pit insures that the ejector drains all water from the sump except the small amount that cannot be taken from the pit.

ARTHUR BELTON *Montreal, Que.*



IMPROVES VALVE-OPERATING-STAND ANCHOR BOLTS

EXPANSION BOLTS that held down the operating stands on our sluice gates worked loose. The bolts went a short distance into the concrete floor as at *A* Fig. 1. To securely anchor the stands we drilled the concrete floor and put in throughbolts as at *B*. When we hit a beam in the concrete we cut an enlarged hole to the beam. We then put the bolt head down in the hole and filled the latter full of molten lead *C*, Fig. 2.

To cut the holes we had to take off the stand while the gate was kept open. To do this we partly closed the gate and removed the holding-down bolts. Then we pried up the stand and gate and held it in position by blocks. This let us put a clamp *D* on the gate stem, as in Fig. 3.

The clamp held the gate open while we removed the stand to cut the holes. When this work was completed the stand was put back on the blocks and raised enough to take the gate's weight off the clamp, which was then removed. We then lowered the stand to the floor and tightened down the nuts to hold the stand securely in position.

F J ARDOLINO *Brooklyn, N. Y.*

SIGNAL LIGHT KEEPS TABS ON COAL SCALE

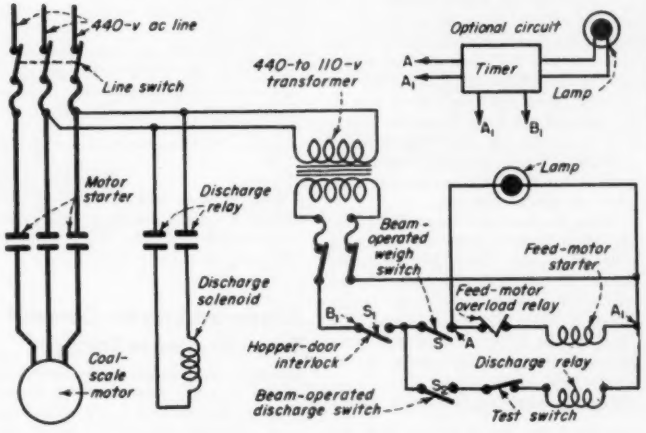
ON OUR automatic coal scale the hopper door sometimes sticks open and stops coal feed to the scale. Because the discharge chute is enclosed the lack of fuel to the boiler may not be noticed until steam pressure starts to drop.

After several schemes failed to insure operation of the scale we put in a signal light as in the drawing. This light is connected across the feeder-motor starter coil. When this coil is energized the lamp lights; it goes out when the coil is dead. If the lamp doesn't light for some time the operator knows the scale has stopped.

When the scale dumps, the weigh beam goes down and closes switch *S*. After the coal runs free of the hopper, switch S_1 closes to start the feeder motor and the lamp lights. Loading the scale causes the weigh beam to rise, closing switch S_2 and energizing discharge-relay coil. Opening *S* puts out signal lamp.

Closing the discharge relay energizes the discharge solenoid to open the hopper door. When this door is released it opens switch S_1 which breaks the circuit to the feeder-motor and discharge relay coils. The scale cannot operate again until coal runs clear of the hopper and its door closes.

The lamp signal has a fault. The fireman gets used to the light going off and on. During light loads the signal may be off for long periods so he may overlook the blinking of the light. But the lamp has served us well.

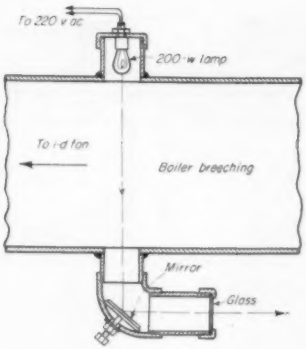


A better system uses a delay timer in the circuit as shown at the top of the drawing. This relay normally tends to close but is kept open by current impulses from the feeder-motor circuit.

The light is always out unless the scale stops longer than the preset time. This interval should exceed the time the scale is idle during minimum boiler load, but not so long that fuel could run short during heavy loads.

W M MONTGOMERY *Des Plaines, Ill.*

(More PRACTICAL IDEAS on page 134)



Lamp and Mirror Make Smoke-Density Indicator

FIREMEN in our plant complained that they had to go outside to see the smoke density at the top of the stack. The diagram shows the simple way we solved this problem

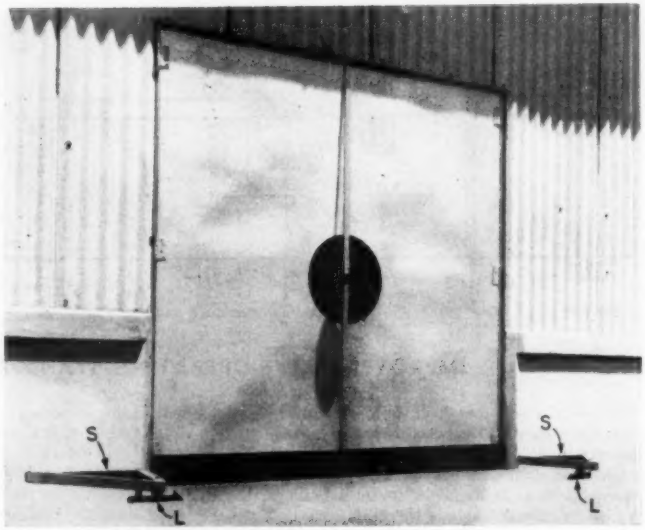
In the boiler breeching we cut a hole and welded in a 10-in. nipple, threaded on its outer end. In the center of a cap for the nipple we cut a hole in which we supported a 200-w lamp and screwed the cap on the nipple.

Directly across the breeching we cut a second hole and welded a 10-in. nipple around it. In a 10-in. 90-deg elbow we put a plate holding a mirror. This plate connects to a rod that goes through a slot in the elbow. By moving the rod we can adjust the mirror until it is at an angle of 45 deg. When the mirror is properly set, the rod is tightened in place with a nut. A nipple with a glass window threads into the elbow to complete the smoke indicator

When the stack gas is clear light from the lamp shines across the breeching onto the mirror. From here it is reflected 45 deg onto the glass window where the firemen can see the lamp's filament. When the smoke is dense they can't see the light. After a little practice they can judge the smoke density by the light on the glass.

MANUAL CADRECHA *Camaguey, Cuba*

EDITORS NOTE: *No doubt this crude device may serve as a smoke indicator, but it lacks several refinements found in commercial types built on this principle. First it does not have a lens to focus the light on the mirror. Also dirt collecting on the lamp and mirror is likely to give trouble. This can be helped by boring holes in the base of the nipples to let air into the breeching. This air tends to keep the dirt away from the lamp and mirror. If Mr. Cadrecha were to install a commercial smoke-density indicator, it will help his firemen to do a better job.*



STOPS PROTECT POWER-PLANT DOORS

DOUBLE DOORS to our power plant were used only when a truck delivered or hauled away heavy equipment. Normally the doors are kept closed so that we can control the ventilation within the building.

To keep the hinges from being damaged when the doors were opened, a pair of triangular stops *S* were fastened to the wall even with the bottom of the doors. These stops, made of 1½-in. angle iron, kept the doors from being opened too far or forced against the building wall. Automatic latches *L* below the frames were spring loaded so that they would catch and hold the doors open until released.

ELTON STERRETT. *Houston, Tex.*

Jumpered Starter Contact Keeps Exciter in Service

ONE OF OUR power-plant operators noticed that the ammeters in a three-phase feeder showed a big unbalance in the currents. We got busy to find the cause. The feeder supplied the motor driving an exciter for a generator that had to be in service to keep the mill running. Inspection of this motor showed it to be running very hot indicating single-phase operation.

While some of us got two fans and set them up to blow air on the motor to help keep it from overheating the rest of us looked for the cause of the trouble. We soon found a contact burned and open on the running side of the motor starter.

The motor could not be stopped without shutting down part of the mill. We decided to jumper the contact—not a simple job to do on the back of a switchboard close to a live bus. But we did it by making up two leads one end of which we connected to a single-pole switch.

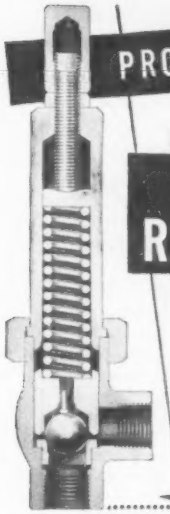
With the switch open we connected the free end of each lead to a contactor terminal. Once this was done closing the switch jumped the contact to close the circuit and put the motor back on three-phase operation.

The jumper served until the next mill shut down for overhaul. This little experience caused us to buy a turbine-driven exciter for emergency service.

C N CARSON, JR. *Tyrone, Pa.*

(More PRACTICAL IDEAS on page 136)

Specify these Edward Steel Valves . . . from the Line that Gives You the Better Designs



PROTECT EQUIPMENT

against abnormal pressure increases with

Edward RELIEF VALVES

Edward relief valves protect equipment against sudden and unusual pressure increases in piping systems. Foolproof design and accurate spring action make them absolutely dependable. One low cost valve can save much expensive equipment.

Used extensively in power, chemical, process, petroleum, hydraulic, marine, and general industrial service, they are particularly suited for relieving pressure in pump lines, drums, heat exchangers, and unfired pressure vessels handling water, steam, oil, or vapor.

They need no packing, maintenance is negligible, and the fine pitch threads of the adjusting screw allow close regulation of pressure setting.

NEW BULLETIN Write for new free bulletin No. 711 containing latest design details, dimensions, weights, and installation information.

Edward PRESENTS *New* ALL-PURPOSE STEEL VALVES

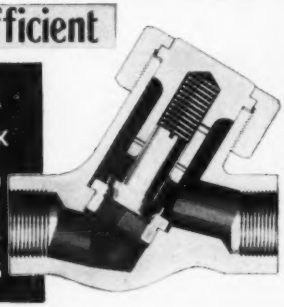
A new all-purpose valve series, ideal for almost any service where small O. S. & Y. steel valves are used. Drop forged steel for greatest strength . . . simplest packing arrangement . . . tight, easily accessible union or bolted bonnet joints . . . bronze yoke bushings . . . microscopically mated seats and disks . . . lock welded parts. Built in sizes ¼ to 2 in. inclusive, globe or angle, screwed or socket welding ends, carbon or chromium molybdenum steels, in 600 or 1500 lb sp classes. Stocks now available.

Bolted bonnet 1-¼ in. up 600 lb, 1 in. up 1500 lb. Union bonnet in smaller sizes.

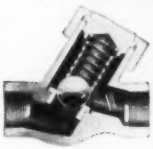
For full details, dimensions, illustrations write today for your free copy of . . . . **BULLETIN 501**

Quiet . . . Efficient

Edward NON-SHOCK Ball & Piston CHECK VALVES



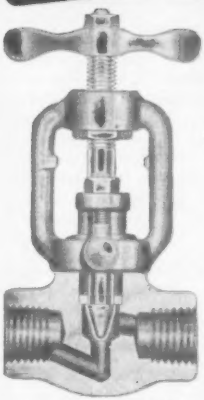
Vibration, clatter, and damaging shock to piping are cut to a minimum with Edward forged steel ball and piston check valves. Cushioned closing action eliminates excessive vibration. Accurate guiding and spring loaded construction assure fast positive seating. EValloy stainless steel seat and ball or piston give maximum trouble-free service.



Union or bolted bonnet in sizes ¼ in. to 2 in. inclusive in two pressure classes —600 lb at 850 F and 1500 lb at 850 F. For complete information, write for Catalog 104.

EDWARD BUILDS Globe and Angle Stop Valves • Integral Bonnet Univalves • Gate Valves • Non-Return Valves • Blow-Off Valves • Feed Line Stop-Check Valves • Intex (Integral Seat) Valves • Instrument Valves • Check Valves • Relief Valves • Hydraulic Valves • Gage Valves • Strainers • Special Designs

PRECISION REGULATION Edward Instrument Valves



New Edward Fig. 952 series instrument valves, so compact they fit limited spaces in such hook-ups as panel boards and manifolds, give precision regulation for meter, gage, regulator, by-pass and instrument lines of all types. Forged steel, globe or angle. Rated 6000 lb WOG, 1500 lb 850 F in carbon steel. Also in stainless steels with higher ratings.

- No bonnet joint to leak.
- Swing bolted gland for easy packing.
- Needle point stem, fine pitch threads for accurate regulation.

WRITE FOR NEW BULLETIN Bulletin 491, with full details, is yours for the asking.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA

Slots in Large Pipe Form Drain Grille

DRAINS IN POWER- and industrial-plant yards are often a problem. At one plant the engineer cut narrow slots to form a grille in the upper section of an 8-in. buried drain, as in the photo. This grille stops sticks, stones and other trash from entering and clogging the drain.

The slots cut in the pipe should have an area equal to the cross-section area of the pipe. The grille will then pass as much water as can be taken away by the drain.

Heavy walled pipe, taken from high-pressure service because of pitting or corrosion, makes good drains. It gives good service and has ample strength for cutting-torch-formed grilles.

ELTON STERRETT. *Houston, Tex.*

Whangs Ball Check to Form New Seat

CHECK VALVES on our steam-engine lubrication have let steam blow back several times when a new valve was not available. In every case we made a repair without shutting down the engine. We took out the spring retainer and spring, leaving the steel ball in place on its seat.

Then we placed a piece of round brass rod against the ball and hit it a sharp blow with a hammer. Then the balls formed a new seat that would not leak and the brass rod couldn't nick the ball. We have tested the new seats under 300-psi air pressure and they remained tight.

W H OSTRANDER, JR. *Chicago, Ill.*

My Biggest Boner

R V Hammond, Hapeville, Ga, forgot that water in the bottom of an air tank can block the bleed valves. But he was lucky—he wasn't even hurt by his boner—ALEC POLLARD

WE INSTALLED a new humidifying system with an air tank about 10 ft long and 4 in. outside dia. I put two ½-in. valves in the plugs in the bottom of the tank to bleed off water from the 40-psi air.

Then I started putting on a control line and gage. I opened the two bleed valves, and since very little air came out, I figured the tank had been cut out. Then I stacked a few bricks on the floor to stand on, and started taking out the 1¼-in. plug from the end of the tank. The plug was right in front of my face as I loosened it, and my arm began to tire. So I stepped down from the bricks for a minute to take a break.

That's when she let go. I thought the whole plant had blown up. I never found the plug but as I dug my wrench out of the floor later, I made this rule—*whenever I work on air lines, I'm going to make certain pressure is off the line.*

FEED PUMP DRIVES CHEMICAL FEEDER

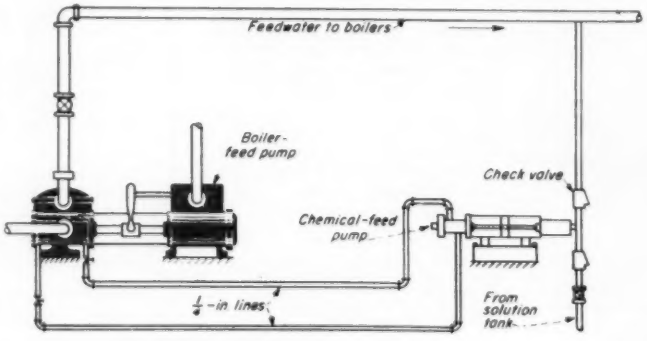
FEEDING CHEMICALS hit-and-miss to boiler feed water is a tale of woe to many engineers. Recently I found a good solution to this problem in our plant.

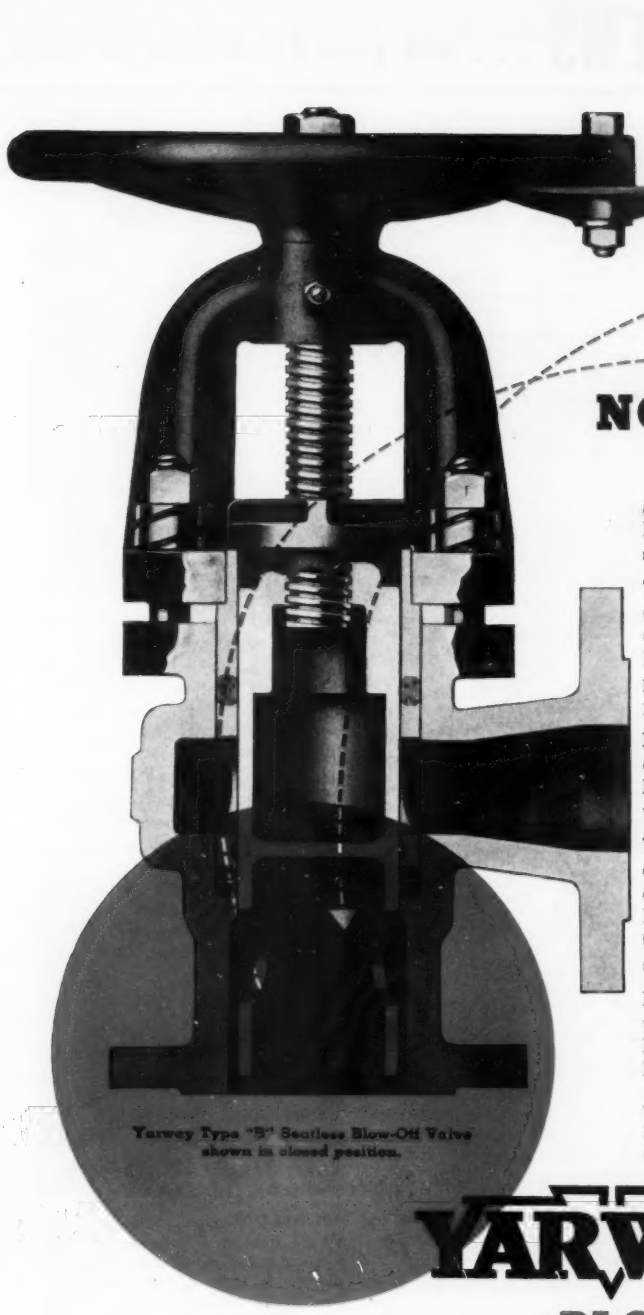
I installed a chemical-feed pump that put compound into the boiler in proportion to the feedwater used. The water is constantly being treated by a given amount of compound.

The chemical-feed pump is pipe connected to the ends of the feed-pump water cylinder, as in the drawing. As pressure builds up in the water cylinder, it does likewise in the drive cylinder of the chemical pump, and they both run at the same speed.

Boiler chemicals are mixed in and fed from a reservoir in which an agitator prevents settling. From here they go directly through the chemical-feed pump into the boiler-feed line. This method has removed a lot of our feedwater-treatment worries.

S NOWAKOWSKI *Chicago, Ill.*





Yarway Type "S" Seatless Blow-Off Valve shown in closed position.

WHAT?

NO SEAT?

● That's right! In this Yarway Blow-Off Valve there is no seat to score, wear, clog and leak.

The unique balanced sliding plunger design eliminates a common cause of blow-down valve trouble—the seat. Many boiler shut-downs are saved . . . power interruptions avoided . . . production speeded.

Latest metallurgical improvements also make Yarway the ideal blow-off valve for difficult service where acid washing is used.

Yarway Seatless Blow-Off Valves are available singly or in tandem combinations for all pressures up to 1500 psi. For higher pressures up to 2500 psi, specify Yarway Stellite-seat valves.

For the latest information on blow-off valves, get Yarway's newest catalog—B-424 for pressures to 400 psi, B-433 for higher pressures.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY

BLOW-OFF VALVES

STOP BLOW-DOWN TROUBLES—KEEP BOILERS ON THE CO

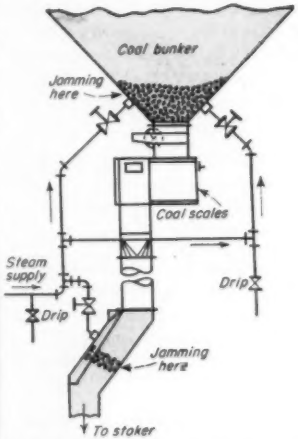
PLANT PROBLEMS . . . *put your know-how to work*

HOW CAN WE STOP BUNKER COAL JAMS?

HERE ARE THE FACTS: Our coal, graded 1½ in. and under, is stored in three large overhead bunkers with downspouts to individual stokers; often coal is mostly fines. When shipped in wet or freezing weather it arches in bunker and downspout. Fireman has to restart coal flow by hand. We've had many anxious moments when coal jammed.

We've been wondering if we could buy or build some device to clear these jams. Sometimes when we rap on bunker underside or downspout with firing tools we can clear the jam. But it doesn't always work. We have both compressed air and electricity handy for driving a device to clear jams. When bunker jam is clear there's seldom any trouble in the downspout. So a vibrator of some sort on bunker might do trick—LS, March POWER.

HERE ARE THE ANSWERS



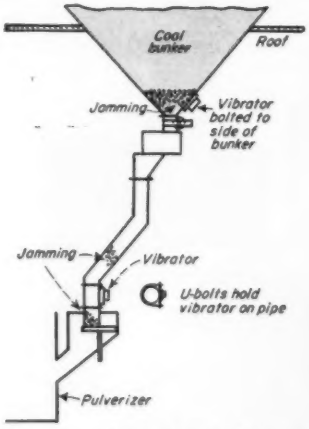
USE JETS. Steam jets spotted where jams occur do good job. Use highest-pressure steam you have and locate jets as in sketch.

A M Palmer *Brooklyn, N.Y.*
J D Waid *Cincinnati, Ohio*

USE ELECTRIC VIBRATOR. Replace offset in chute with a straight smooth piece. Don't leave any pockets for coal to collect in. Air vibrators may also be used if desired. Use stainless-steel lining wherever possible.

E H Roper *Toledo, Ohio*
Vincent Strojsa *Glace Bay, N. S.*
J C Porter *Rock Hill, S.C.*
R A Lane *Three Rivers, Que.*

ALARMS. They are needed for all systems using vibrators. We have a paddle



that rides coal on scale belt. When coal flow stops paddle drops, rotating a mercury switch that energizes an alarm. Downspout has lighted sight glass about four feet above the turntable to show coal flow past this point. Electric vibrators, sketch, have done good job for us.

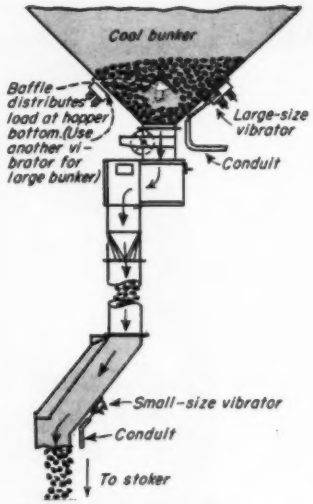
Clyde L Bovee *Oneida, N.Y.*

HAVE SUITABLE CONTROLS. These are needed on air or electric vibrators. Drain air lines to prevent freezing.

Clyde G Howarter *Canton, Ill.*

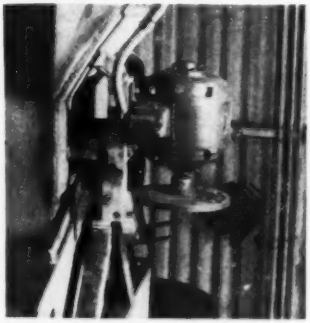
REDESIGNING BIN. It solved similar problem for us. We made two adjoining sides of bin vertical. This stopped arching. In larger bins we installed vertical partitions dividing them into four parts.

M G Bittel *North Hills, Pa.*



ELECTRIC VIBRATORS. Be sure you select right size for your job or else some jams might still occur. Use them on bunker and downspout (*as in Gozdenovich's sketch above*—Ed.)

M N Gozdenovich *Pearl River, N.Y.*
T A Muellerleile *Owatonna, Minn.*
Melvin Evans *Chicago, Ill.*

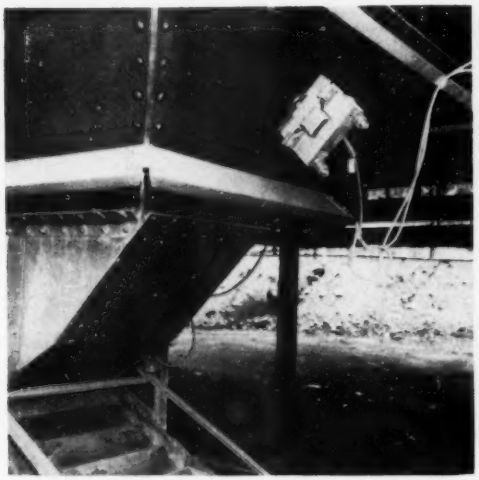


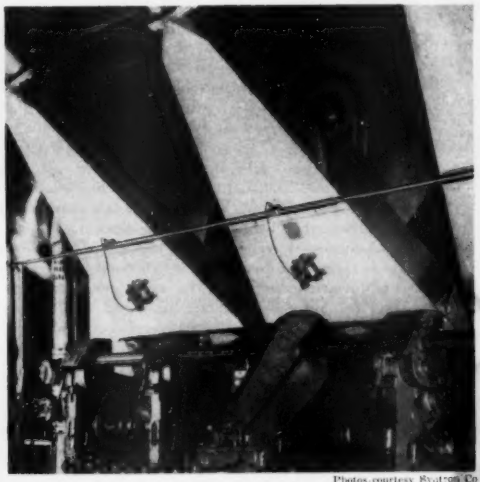
TRY THIS ONE. Vibrators we use on coal chutes have a 1-hp, 1800-rpm, ball-bearing motor mounted on chute, photo above. It spins a 10-in. dia, ⅝-in.-thick steel flywheel that has six 1-in. holes drilled in it to throw it off balance. We run motor for 5 sec, 150 times a day. Be sure to guard flywheel; guard was removed to take photo.

G C Lewis *Vancouver, B.C.*

help the other guy cure his headaches

TYLER HICKS, *Assistant Editor*

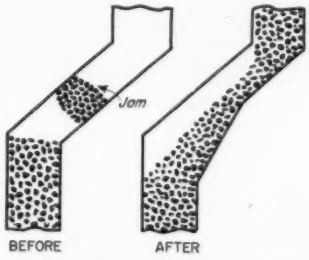




Photos courtesy Syntron Co

USE VIBRATORS. Unless coal is frozen into a block of ice vibrators should make it flow. Photos, *above*, show how one type vibrator is mounted on bin and downspout. With badly frozen coal use steam hose first, then vibrator. Or mount steam jets on side of bunker; point them into coal.

J B DRAB *San Francisco, Calif.*

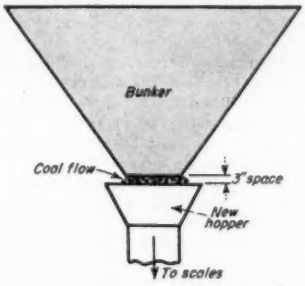


CHANGE CHUTE ANGLE. Coal jams against top and bottom of chute. Sketch, above left, shows how this happens. Change angle of bottom as in right sketch. Then coal can't jam against top or bottom of the chute. Experiment with the new chute arrangement before welding sides and top together.

WILLIAM E BELL *Salem, Mich.*

AIR LANCE. Wet coal gives us plenty of trouble. Cure it like this. Cut hole in bunker neck and weld 3-in. pipe nipple to it; fit with cap. Make a 6-ft-long air lance of ½-in. pipe and connect it to a 100-psi air line. When coal jams, remove cap, insert lance and blast coal loose with air stream. Air also dries coal. Lining narrow parts of coal chutes and hoppers with stainless steel helps stop jams, too.

J C TORREANO *Calumet, Mich.*



INSTALL HOPPER. Reduce bunker height and fit hopper as in sketch. This allows coal to spread out and flow down hopper center. Use rod in gap if there is any jamming.

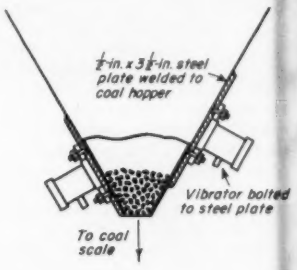
G O ELLIOTT *Riverside, Ont.*

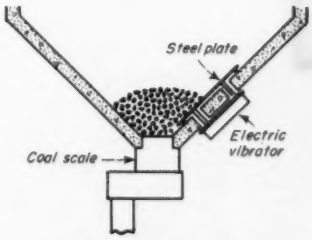
INSERT compressed-air nozzle in nipples along chute to clear jams. Also use stainless steel where jams occur.

A J BREUGELMANS *Hoboken, N. J.*

PROTECT BUNKER. Fit bunker outlet with monel-clad steel plate, running it up about 3 ft above coal gate. This prevents build-up of wet coal. Glass or porcelain lining can do just as good a job as monel, may be easier to get. Use electric vibrator if you fit monel nose to bunker.

W C JUSTICE *Silver Spring, Md.*





AIR-OPERATED vibrators. They work right when installed as in top sketch. For concrete bunker and electric vibrator use method in bottom sketch. Electric vibrator prevents downspout jam, too.

BROTHER BEATUS, C.S.C. *Notre Dame, Ind.*

More PLANT PROBLEMS

WHY DOES ELECTRIC ROTOR OSCILLATE?

HERE ARE THE FACTS: Two turbo-generators run in parallel, one 550 kw, one 750 kw. At times the rotor of 750-kw machine oscillates to and fro quite severely, as much as ¼ in. Once started it's hard to stop. What causes this and will more trouble develop?

Here are some things we've done to find the trouble: (1) We have watched the governor for hunting but the first-stage pressure gage holds steady (2) watched the voltage regulator show no erratic movement and voltage hold steady (3) removed voltage regulator of little machine (make-and-break-type) and controlled voltage manually (4) varied speeds and loads of two machines to quiet oscillation (it runs true for three or four weeks).

Both machines are running to capacity. The dc current to collector rings is connected direct with no rheostat in the rotor field. Exciters are motor-generator sets. The main generators are aircooled with a duct leading outside, both connected to discharge of one duct. The collector rings are cleaned every week and we reverse the polarity of the rings about every four months to get uniform wear on the rings—CWBD.

HERE ARE THE ANSWERS

HOW TO CORRECT. I had similar trouble with three turbo generators in various plants. Oscillation is from angular misalignment. Coupling, my sketch *A*, shows condition producing endwise thrust that pushes rotor out of magnetic balance in stator. This causes two opposing forces of varying magnitude in opposite directions, one mechanical, the other magnetic. Then rotor oscillates, at intervals.

Line up generator shaft with turbine shaft, so they're both parallel and concentric. Use dial indicator, sketch *B*, for concentric alignment. If coupling is type in sketch, remove flange casing from both halves.

Clamp dial indicator to one half and set dial to zero. Mark spot and rotate both shafts one half turn. Note reading. Then turn shafts to both quarters, taking readings again.

For parallel readings, use inside mike as shown. Take readings on all four quarters. Readings must have no tolerance. Again rotate both shafts so readings are taken at same points.

Most turbo-generators have adjustable bearings for final adjustment of generator shaft and turbine shaft. Sketch *C* is popular bearing design, with spherical pads fitted to four bosses on bearing shell. There are shims under each pad, fastened with two filister-head countersunk screws. Bearing is self aligning ball-and-socket type. If 0.015 in. is removed from one side to align shaft, for example, then shim must be placed on the opposite side to keep spherical diameter same size. In other words, transferring shims to opposite side does not change fit of ball in socket.

Oscillating condition indicates a change in bearing condition. One or more bearings must be worn or burnt to permit shaft to go out of line.

Before starting this bearing overhaul job, have on hand a set of main-bearing shells. That avoids delay in completing the job. When shaft is aligned right, set air gap in generator with feeler gauges made for this purpose, sketch D. Make air gap even at each quarter, on both ends. Move stator on base if necessary by reaming dowell holes to next larger size. Then use new tapered dowell pins.

Sketch *D* shows rotor and stator in position of magnetic balance, both endwise and concentric. Turbine manufacturer will give details for machine.

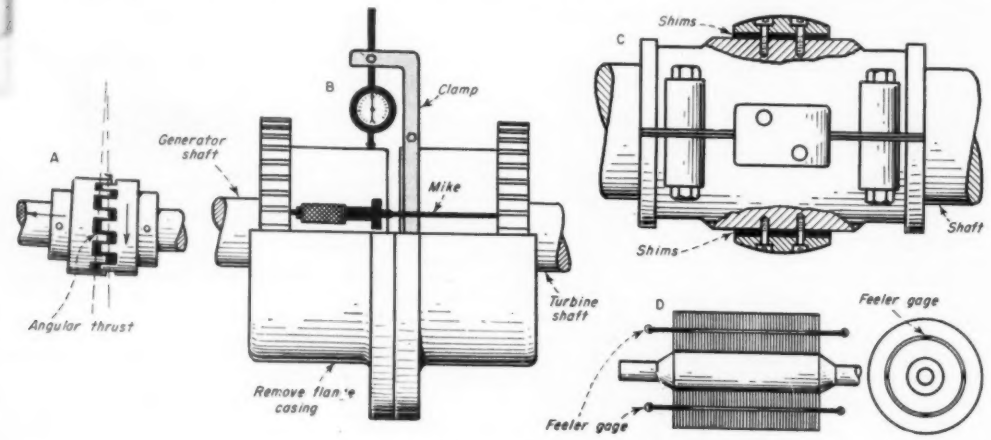
S C Page *Buffalo, N. Y.*

FLYWHEEL EFFECT. Oscillations of rotating machinery usually result from critical frequencies in dangerous range of flywheel effect.

There are mathematical formulae to determine critical frequencies and rules to change the fly-wheel effect to eliminate critical frequencies. But this can not be done successfully without getting data from manufacturer. Chances are some of these factors are hard to find. Sometimes, torsional vibrations play a very important part.

I advise calling in turbo manufacturer's engineer. Have them determine these mathematical factors and steps needed to correct flywheel effect to avoid bad oscillations.

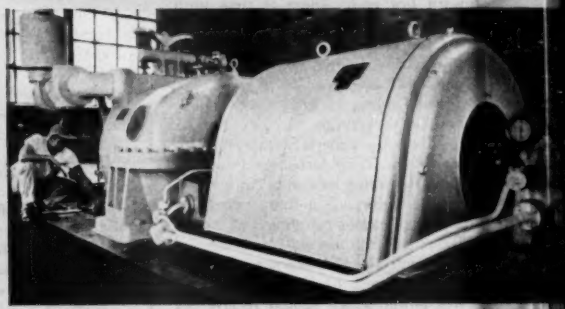
There are many load and power factors on generators which may affect



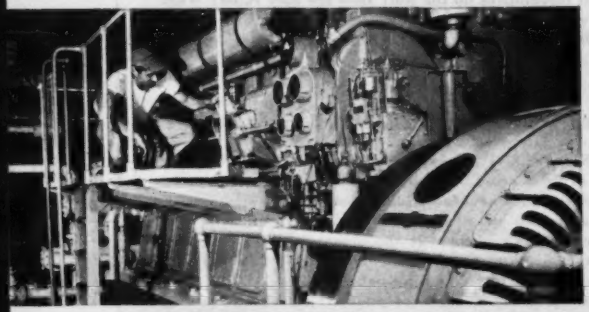
NANTUCKET ISLAND can't tie in with mainland power facilities and must therefore be entirely self-sufficient. To assure unfailing performance, the Nantucket Gas & Electric Company uses Sun lubricants exclusively. Also, engineers of the utility, of the diesel builders, and of Sun Oil cooperated to make possible a unique, three-way use of one inexpensive Sun fuel.

HOW SUN PROTECTS NANTUCKET'S POWER

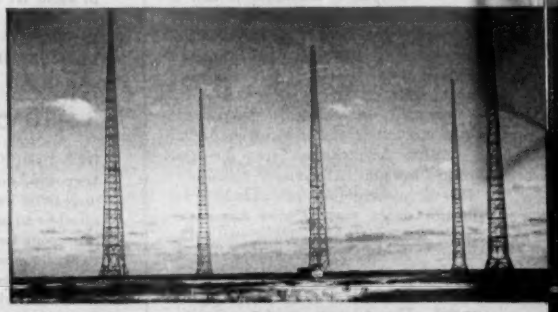
THE ISLAND'S POPULATION drops from around 16,000 to some 3,800 when the vacation season ends. With the power load fallen off so drastically, much of NG&E's equipment lies idle and subject to condensation during this extended time.



DESPITE IDLENESS for considerable periods, turbine journals, bearings and controls remain free at all times of sludge, rusting and corrosion—thanks to the protection of Sunvis 916. Its special metal-wetting additives displace any moisture that may be present.



A SUN DIESEL LUBRICANT has kept this 1,000-hp engine purring almost 15,000 hours. A single heavy, low-cost Sun fuel drives NG&E's diesel, fires its boilers, enriches its illuminating gas.



POWER for a new navigational transmitter, throwing a 1,700-mile beam for guiding aircraft, is supplied by Nantucket G&E—more evidence of the reliance placed on its Sun-lubricated plant.

For complete information about Sun's turbine and diesel oils, or for the services of a Sun representative, call the nearest Sun Office, or write to Dept. P6

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO®

More PLANT PROBLEMS

turbine speeds regardless of governor's sensitivity, variations in steam pressure on turbine blades, or other conditions. All of them may contribute to critical speed causing these oscillations.

The fact that large turbine runs for a while without oscillation trouble may mean that contributing factors were not always present.

Beware! If oscillations are bad as stated, it won't be long before something serious happens. Consult manufacturers at once and get their advice. They may be responsible for condition.

E L KYLE *Detroit, Mich.*

GOOD TECHNICAL INFO. Bearing wear or foundation setting may have caused the generator rotor to list slightly from horizontal. This causes rotor to slide toward low end. There it runs until the generator is excited; then rotor seeks the electrical center of machine. But electrical center no longer corresponds with rest position of rotor.

Force tending to bring rotor uphill would be very large. Surging has an end thrust on generator that it's not designed for. This force is also on the turbine if surging motion is transmitted beyond coupling. If nothing more, this end motion causes coupling wear.

Rotor surging may be due to a surging current. CWBD does not mention a possible surging of either real or reactive power which should receive his attention. A small installation such as this, being independent from stabilizing effect of connection with a utility, must take reactive power as it comes.

For example, if machines *A* and *B* carry a reactive load equally and the induced voltage of *A* is increased, either by changing the excitation or by a change of speed of *A*, it will take more lagging RKVA and *B* will take less.

Inequality of excitation is equalized by a circulating reactive current which "transfers the excitation" from the overexcited machine to the underexcited one. This circulating (and probably surging in this case) current may cause the rotor to pulsate lengthwise with the shaft.

Before going further, run the 750-kw machine without load at synchronous speed. Then change machines excitation from minimum to maximum. Do this in any way that might duplicate trouble to see if you can cause the rotor to pulse.

CWBD asks, "will more trouble develop?" It certainly will. The coupling is taking a beating and its life will be materially shortened. Should it break with the machine under load, not only will the turbine lose its load, but the generator will motorize and, no doubt, take everything off the line presto.

W MONTGOMERY *Des Plaines, Ill.*

THINGS TO CHECK. I believe electric rotor is slightly out of true level. When running, rotor tends to slide towards low end of unit.

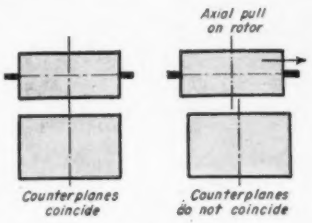
Rotor weight, because of momentum, tries to overcome the field strength which should keep rotor in center. Having started to swing, this condition continues like a pendulum action.

Check rotor for true level, also test air gap all around.

GEO MCNALLY *Kearny, N. J.*

UNBALANCE. Oscillation trouble may be due to an axial electrical-mechanical unbalance at large loads.

When shut down, the mechanical counterplanes of rotor and stator coincide, sketch above right. But at full load, the electrical center of one, either



rotor or stator, does not coincide with its mechanical centerplane, above.

This axial magnetic and electrical unbalance sets up a force. This force tends to axially push rotor to bring together magnetic and electrical centerplanes of rotor and stator.

Remedy by axially shimming the rotor poles, or stator, to make the full-load electrical centerplanes coincide.

W H MILLER *Lancaster, Pa.*

(*Continued on page 218*)

YOUR NEW PROBLEMS

—How Can We Generate Steam in Emergency?

OUR CENTRAL HEATING plant has seven pulverized-coal-fired boilers. In cold weather we generate up to 250,000 lb of steam per hour. If we lost our steaming capacity from sabotage or other causes several thousand people would not be able to work because we have no stand-by equipment to produce heat. In addition we'd have all sorts of troubles with frozen lines, traps and valves.

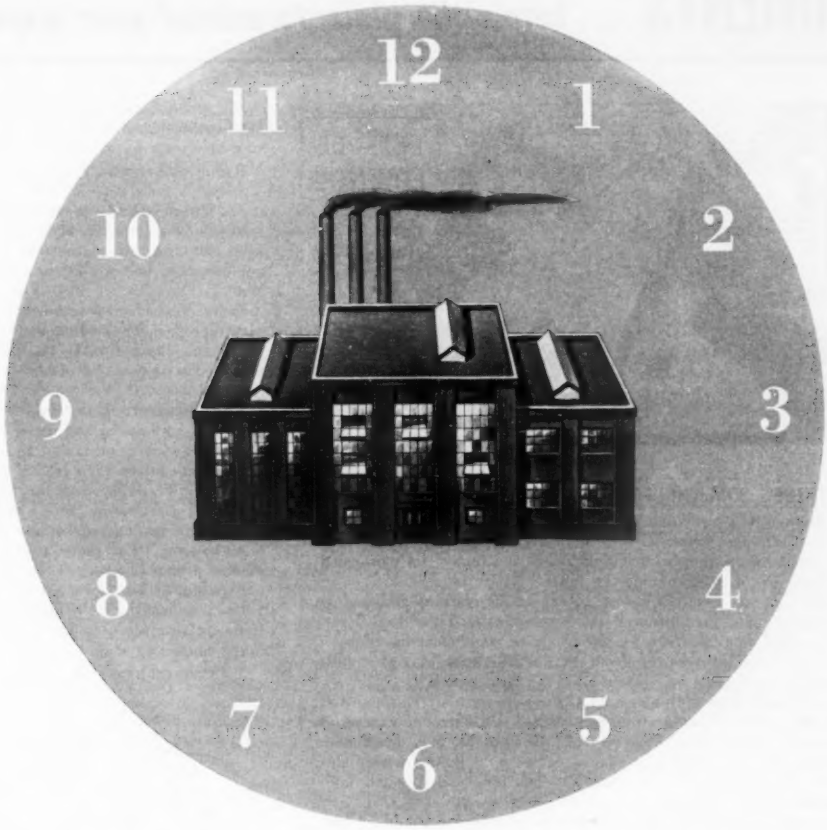
How could we produce steam during an emergency? Some of the boys have suggested using locomotives. These could pull into our siding and hook into the steam lines. We have ample coal supply and cranes to handle it, and a good water supply. What we'd like to know is: will locomotives do the job? How are they rated? What connections are needed for them? What would we do with return condensate? Or is there a better way of solving this problem? If so, how?—HS

—How Can We Clean Air-Conditioning Ducts?

OUR INDUSTRIAL PLANT is completely air conditioned. We must keep dust out of work areas because it spoils manufactured goods, increasing rejects. Our manufacturing spaces are divided into a number of small rooms served by supply and return ducts. These run from large plenum chambers in the basement. Two fans and air washers supply air, the fans taking air in from above the building roof. We use standard filters in air intakes.

Now here's our problem. We get complaints from manufacturing areas about excessive dust entering the rooms. Their complaints are right; I often find dust around the return grilles in many rooms. We've tried several schemes for removing dust from ducts and plenums but none have worked well. Another problem we run into is excessive dust in rooms immediately after cleaning.

Are there any readers who've solved the duct-cleaning problem in a way that would help us? We need sketches and details of easiest and fastest way to clean our ducts effectively. The more dust we can keep out of the plant the happier we'll be—GS



How to be sure of 'round-the-clock' production

This is The BETZ INDICATOR, a monthly publication devoted to general discussion of all *water problems. It's free. Write.*

Any way you look at it, improper water conditioning resulting in scale, foaming, corrosion, algae, embrittlement or a host of other "traditional bugaboos", is one sure way to stymie efficient plant operation . . . and pile up costs! That's why alert management recognizes that a direct route to uninterrupted production is through the use of an adequate and well-balanced program of water conditioning.

If *you* are result-conscious, then BETZ can be of assistance to you. Here in one organization you will find the facilities and services necessary for the efficient solution of all water problems. May we have a BETZ engineer call? He'll show you how you can get 'round-the-clock' results in your plant . . . quickly . . . economically. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal, 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

ARGUMENTS . . . *here's the place to unload your gripes to*

THERE'S SOMETHING SMELLY ABOUT THIS STORY

I ONCE WORKED in a big buiding which supplied heat through underfloor piping in a 3-ft space between joists and "*terra firma.*" The only access was by a small swing window. The light switch was thoughtfully provided in the center of the space among the pipes.

One day heat was reported scarce, so one of the workers gathered in some wrenches and hied through the window toward the heat lines. He had to crawl on all fours to get into where he could clear the traps.

He says he heard a rat scurry ahead, but he thought nothing of it until he dropped his wrenches and reached for the light switch.

Sight and smell were both activated at the same instant. Gasping and choking, he at length found strength to survey his surroundings. And there they were before him—lined up like little toy soldiers at attention—one momma and five junior size skunks. They were quite friendly and interested, but only because their bazookas had fired and they felt safe. They were!

Their victim had to plead loud and long before anyone would let him back into the power plant. And it took plenty of soap to make him even passing sweet.

But on expert advice he soaked his raiment in tomato juice and then buried it with pretty fair results. So here's a tip to those who run afoul of a skunk; *tomato juice is the only (though still not too sure) cure for skunk aroma.*

BERT RICHARDS *Toronto, Ont.*

EDITOR'S NOTE: *Like other advice, this is of no use—unless you need it.*

Records or Rocks?

IN REPLY to the letter from A A Ross, p 53, Mar OE, regarding O L Applegate's system of keeping maintenance records, Mr Ross dosen't give a reason as to why record-keeping is impractical. Nor did he offer a better system. Certainly no system at all is not in keeping with modern engineering ways and means.

Any maintenance program must have a recording system to make it effective and efficient. Our Chief Engineer keeps records on all his equipment aside from maintenance records. In this way he can tell at a glance what has been done and when it was done.

And I don't see how anyone could keep these records in his mind. If you can, Mr Ross, you are blessed with a brilliant mind.

I have been reading POWER and OE for many years, and during this time I've found most plants do have some system of recording maintenance.

Surely Mr Ross is thinking of very small plants.

G E GHIDINA *Pekin, Ill.*

. . . I don't know how many records Mr Ross can keep in his head, but I'm sure he's got a lot of rocks up there.

B TOWNSEND *San Francisco, Cal.*

. . . I would like to say that Mr Ross is the only engineer I know who can keep the information necessary to proper operation and top efficiency in his head.

Every plant needs records. Most plants, especially medium-and small-size plants, have trouble for the very reason that they don't bother to keep records.

After going to sea for several years, acquiring both steam and diesel licenses, coming ashore and taking up several instruction courses, then getting my stationary-engineer's license, going to night school for a couple of years I find that I'm not an engineer according to the one who says, "If all the records needed in the power plant can't be kept in one's head, he isn't an engineer."

I've been making my living out of this trade for several years. I'm glad I was never caught up with.

T F CUNNINGHAM *Philadelphia, Pa.*

HERE'S MY IDEA of how a man would look who could keep records in his head

BEN ROTHMAN *St. Louis, Mo.*

The More Oil Grooves The Better

I'VE BEEN MEANING to write to you about "Operator's Notebook No. 37", p 32, Jan OE, for a long time.

The first oil groove I ever cut was in

editors, manufacturers, fellow engineers

ALEC POLLARD, *Assistant Editor*

1909 at the old Himes Brewery, East St Louis, Ill. And it was the cross groove that Steven Elonka says should never be cut.

Now I don't want to start a foolish argument, but I have been cross-grooving bearings all my life. And I might say I've worked up a reputation for cutting grooves faster than anyone in shops I worked in.

My theory has always been to cut as many grooves as possible to distribute the oil freely. Now if that's not the purpose of a groove, what is?

This business about "hydraulic pressure" being destroyed by grooving the pressure areas is just a lot of fancy talk. My bearings always did the job and held up well.

Mark my words—before long this fad will drop like others have and we'll be back to grooving bearings as we did in the good old days. It's faster and easier.

J O SHELBY *Indianapolis, Ind.*

Catching Up On His Reading

IT'S SURPRISING how much you miss if you ever let yourself get behind in reading. If I hadn't gotten behind I would long ago have had a word answering FLS's question on overspeed control for duplex pumps, Nov 1950, OE, p 66.

It's strange that no one mentioned the

(*continued on page 224*)

NORTH-EAST-SOUTH-WEST (continued from page 111)

tions to read at one time. This merger renders a real service to the men who want to keep abreast of new developments."

JOSEPH KRONKE, *Plant Eng* *Murray Packing Co*
Kalamazoo

MINNESOTA

"It's a grand stroke of editorial genius. Will miss OE on account of the folded-pamphlet type of binding and its down-to-earth, basic, meaty fundamentals for the apprentice student, journeyman and master craftsmen in all engineering trades. A new-found friend has been buried."

CY A HEDLUND, *Plant Eng* *F G & Co*
Winona

EDITOR'S NOTE: *No, Mr. Hedlund, not "buried," just moved into a bigger house*—PHIL SWAIN.

MISSOURI

"I have benefited by reading OE and expect to get even more from new POWER. You as editor and the guiding force behind this big publication, are one of the great men in my life. If and when I get back to New York, I would appreciate the honor and privilege of meeting you."

E E RUTHERFORD, *Engr* *Brown Shoe Co*
St Louis

NEBRASKA

"I think this merger of POWER and OE is a good thing. I was ready to change to OE, but now I am sure I will enjoy POWER more than ever."

J J WILFING, *Oper Engr* *Veterans Hospital*
Omaha

"Best thing you ever did for operating men."

N J FISK, *Engr* *Eggers-O'Flyng Co*
Omaha

NEW YORK

"The combined issue of POWER and OPERATING ENGINEER meets with my heartiest approval. I am glad to see one of my former shipmates, Steve Elonka, doing so well."

WM BENKUS, *Asst Port Engr*
New York City

OHIO

"POWER combined with OPERATING ENGINEER is a masterpiece and should be received with a happy welcome by power plants or any place where steam or electricity is made or used.

F D MACFARLAND, *Ch Elec* *Lowellville Plant*
Akron *Ohio Edison Co*

OREGON

"The addition of OE to POWER magazine makes a combination we all like to read."

W H HOLT, *Ch Engr* *Medford Corp*
Medford

SOUTH CAROLINA

"It should have been done long ago. Better late than never and I mean it is really better."

H M GEER, *Watch Engr* *Celanese Corporation*
Rock Hill

SOUTH DAKOTA

"We like the combination of OPERATING ENGINEER into POWER."

O C STOKKE, *Supt Prod* *N W Public Service Co*
Huron

VERMONT

"I would like to say that, in my estimation, it is definitely a great publication—in every respect."

JOHN W HOOPER *Porter Screen Co*
Burlington

VIRGINIA

"It's a wonderful idea to combine theory and practice."

R L GRAHAM, *Branch Mgr* *American Blower Corp*
Richmond

WASHINGTON

"Am well pleased with the combination of two magazines, POWER and OPERATING ENGINEER. I have always enjoyed both magazines, and now having the two in one makes it better."

WILLIAM S HERBERT
Seattle

WISCONSIN

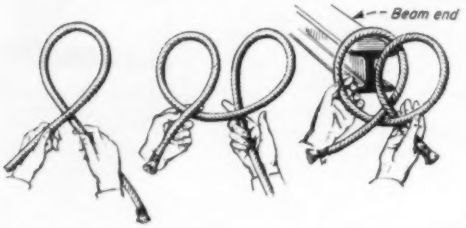
"You have done a good job. I believe you are now serving both the technical and practical engineer."

W C SCHUBERT, *Engr Officer* *Veterans Adm Hosp*
Madison

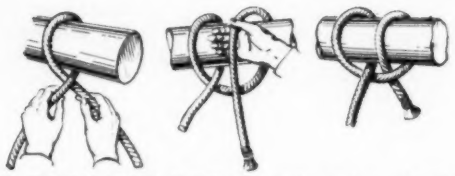
HOW TO TIE THE RIGHT KNOT IN A JIFFY

By H B McDERMID, Cincinnati, Ohio

CLOVE HITCH

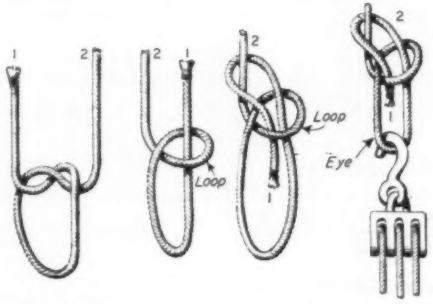


FOR MAINTENANCE WORK around the plant, the clove hitch is one of the most useful knots. Make single loop with two hands. Then make a second loop with right hand. Now move second loop over first loop and slide over beam end or load



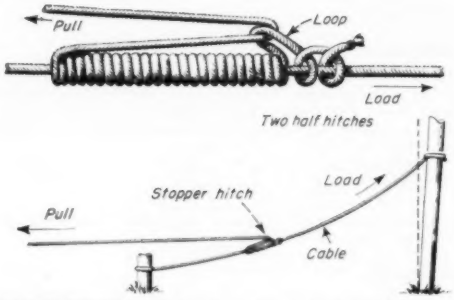
TIE CLOVE HITCH IN PLACE around pipe or beam like this. Throw loop over pipe, cross rope end underneath, then over pipe. Stick end of rope through cross-under loop. This knot won't slip and yet can be untied with no trouble at all

BOWLINE



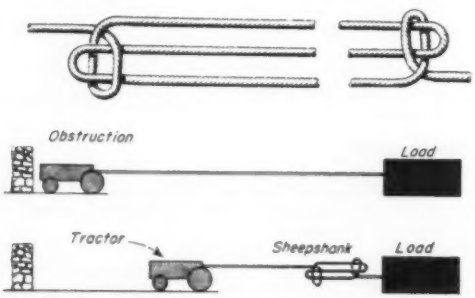
HERE'S A MUST. To tie bowline quickly, tie an ordinary overhand knot. Flip end 1 over to form loop. Tuck end 1 behind end 2 and down through loop. One of many uses is to form eye on end of line as shown. Knot unties very easily

STOPPER HITCH



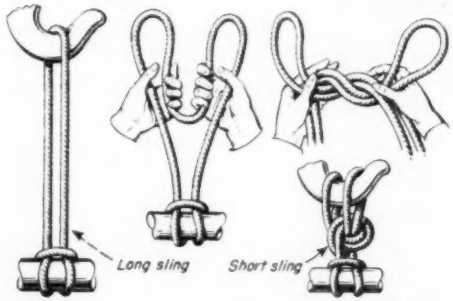
FOR TIGHTENING LINE already under strain, the stopper hitch is best. Coil rope around line to be tightened and allow for loop, with two half hitches as shown. This knot stays in place on cable or rope and won't slip on hard surface

SHEEPSHANK



TO SHORTEN a long line without untying or cutting rope, use the sheepshank. For example, if a long line is needed to tie on to a load and then, because of obstruction, line must be shortened, back up tractor and tie a sheepshank

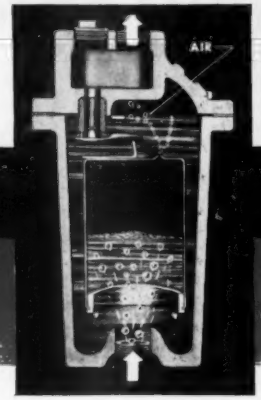
SLING SHORTENER



SHORT SLING can be made from long sling easily when there isn't enough head room. Form into two loops and tie overhand knot. Then place two loops over hook. This knot saves having too many slings of different sizes around the plant

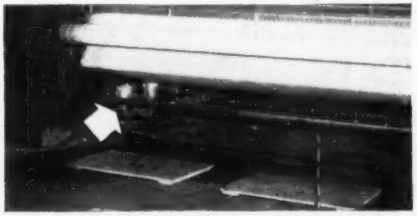
Armstrong traps vent air to give you hotter machines

HIGHER TEMPERATURES MEAN MORE OUTPUT



PSIG	Temp. of Steam with No Air Present	Temperature of Steam Mixed with Various Amounts of Air. (Per Cent Air by Volume)		
		10%	20%	30%
10.3	240.1	234.3	228.0	220.9
25.3	267.3	261.0	254.1	246.4
50.3	298.0	291.0	283.5	275.1
75.3	320.3	312.9	304.8	295.9
100.3	338.1	330.3	321.8	312.4

THIS TABLE TELLS THE STORY. You can't get the maximum temperature you need unless you get the air out.



PYROMETER TESTS SHOWS 30° TEMPERATURE INCREASE on flatwork ironer rolls at *Peter Bent Brigham Hospital, Boston,* after installation of Armstrong traps which vent air along with condensate.

EVERY time an Armstrong steam trap opens there is a momentary pressure drop which "pumps" air down to the trap from the unit being drained. The air passes through the bucket vent and accumulates at the top of the trap to be discharged along with condensate each time the valve opens.

This one basic benefit of the Armstrong trap is saving industry thousands upon thousands of dollars through faster heat-up and higher, more uniform temperatures with resultant greater output and time and labor savings.

You can have this benefit. The cost of Armstrong traps is small in relation to the efficiencies they effect. Call your nearby Armstrong Representative today.

ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

HOW TO SELECT the right trap for each application, installation pointers, prices, capacities, other facts and figures are contained in the 36-page STEAM TRAP BOOK. Send for your copy.

ARMSTRONG STEAM TRAPS

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

How Forces Balance—3

► Now we come to what is variously known as torque, moment, or twisting effect. This business of leverage is something every practical man understands to some degree. Yet even practical men have been known to fall for phoney lever stunts. I have in mind those curved cast-iron handles once used to crank the old oaken buckets out of the wells.

The men who cast those handles were either fooling themselves or their farmer customers, because the curve of the handle doesn't help a bit. The lever arm is exactly the same as with a straight crank measuring the same in a straight line from axle to handle.

So let's pin down a few fundamentals. You apply a force to a wheel, lever or other body operating on a shaft, pivot or fulcrum. To figure the torque, moment or twisting effect (they are all the same thing), multiply the amount of the force by the lever arm. *Be sure to measure the lever arm from the center of rotation along a line perpendicular to the direction of action of the force.*

Say a man is pushing 50 lb at the end of a 20-lb pump handle. If he is pushing square with a line drawn from his hand to the center of rotation, the effect or moment or torque is 50 × 20 = 1000 pound inches. But let's say he is careless and pushes at a less effective angle so that the perpendicular from the center to the line of action of his push is only 18 inches. Then his torque is 50 × 18 = 900 pound inches.

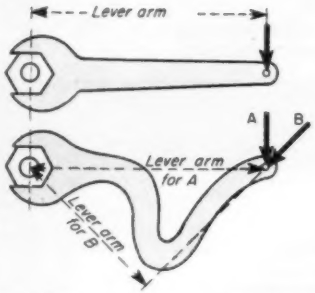
In many cases a single clockwise torque balances a single counterclockwise torque. In the usual problem, both lever arms and one force are known. What is the unknown force? The logical procedure is to write

one torque = other torque, or
unknown force times its arm
= known force times its arm

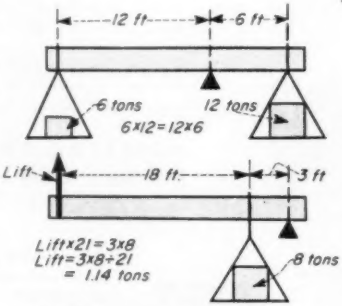
Then solve this equation for the unknown.

Problem: What force at 10-in. arm balances 25 lb at 15-in. arm?

One torque = other torque
10 × unknown = 25 × 15 = 375 lb-in.
Unknown = 375 ÷ 10 = 37.5 lb.



LEVERAGE. To find the true lever arm pay no attention to the shape of the actual arm. Just measure the *perpendicular* distance from the pivot or center to the *direction line* of the applied force. To get torque, moment or twisting effect multiply the lever arm by the applied force. Note that the crooked wrench will serve as well as the straight one if your push (as in *A*) is at right angles with the line from the center to the point of application of the force.

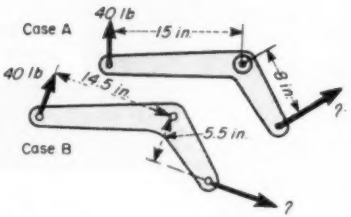


BALANCING. Everybody knows that the smaller child must sit farther out on the see saw. In any lever involving a fulcrum and two balanced forces one force creates a clockwise torque and the other a counterclockwise torque. For balance the two torques must be equal. Thus, in the first lever

6 × 12 = 12 × 6 = 72 lb in. torque

In the next example:

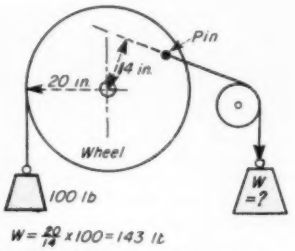
lift × 21 = 3 × 8 = 24 ton ft,
so lift = 24 ÷ 21 = 1.14 tons



BELL CRANKS. The same law applies to bell-crank levers and all sorts of irregular shapes. Just forget the shape of the arms. Note where the forces are applied and the exact directions of the forces. Then drop perpendiculars from the pivot to these direction lines. The lengths of these perpendiculars are the true lever arms.

In the first example (Case *A*) the forces are applied square with the lines connecting the centers of the holes. Then the center distances, 15 in. and 8 in., are the true lever arms. Then 8 × unknown = 15 × 40 = 600 lb in. And unknown = 600 ÷ 8 = 75 lb.

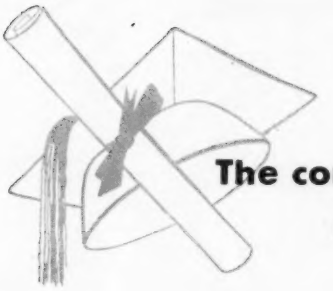
In the second example the lever arms measure 14.5 in. and 5.5 in., so 5.5 × unknown = 14.5 × 40 = 580 lb in. and unknown = 580 ÷ 5.5 = 105 lb



$W = \frac{20}{14} \times 100 = 143$ lb

SPECIAL CASES. The disk problem pictured shows how easy it is to solve all sorts of special problems if you have a clear understanding of torque. Note that the 100-lb weight, acting on a tangent to the wheel, exerts a counterclockwise torque of 20 × 100 = 2000 lb in. Torque of the unknown weight is 14 × W.

Then 14 × W = 2000
and W = 2000 ÷ 14 = 143 lb



The condenser tube most likely to succeed

The college graduate voted *most likely to succeed* may be a misfit in the job he gets.

It's the same with condenser tubes.

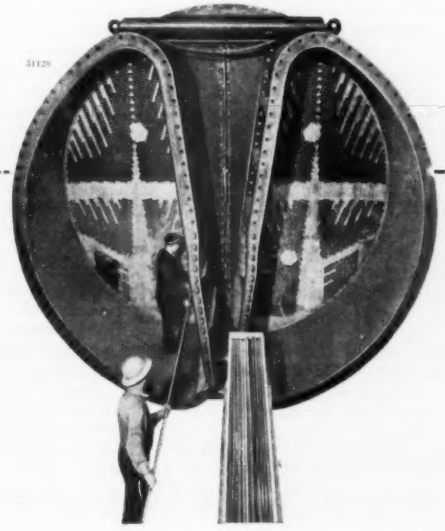
When our engineers suggest a specific tube as most likely to succeed in your condenser, you can be sure their opinion is firmly founded on facts.

The American Brass Company's engineers are backed by accurate information on the performance and cost of tube materials under many operating conditions.

The experience and counsel of our Technical Department are at your service. Just write to The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

ANACONDA CONDENSER AND HEAT EXCHANGER TUBE ALLOYS

Arsenical Admiralty 439
Ambraloy 927 (Aluminum Brass)
(U. S. Patent No. 2,003,685)
Ambraloy 901 (Aluminum Bronze)
Super-Nickel 702
Cupro-Nickel 754 (U. S. Patent No. 2,074,604)
Red Brass 24 (85%)
Deoxidized Arsenical Copper 108
Deoxidized Copper 939



for efficient heat transfer

ANACONDA®

CONDENSER TUBES

"Donovan kicked the pile of grate bars . . ."

Donovan Makes A 'Grate' Deal

"Ship me someuheres East of Suez,
Where the best is like the worst,
Where there ain't no Ten Commandments
An' a man can raise a thirst" . . .

. . . with these immortal lines from Kipling, George McNally of Kearney, N. J., toasted old sailing days at the Bent Propeller Bar the other day.

George and I went there to talk ships and take a look-see at that old walrus, Marmaduke Surfaceblow. George did his sailing under the Union Jack and knocked around the globe quite a bit himself.

As usual, the Bent Propeller's star customer, Marmaduke, was meditating over his bottle of Sandpaper Gin and wasn't talking to anyone. But when he heard those lines, he straightened up like a South Seas tramp coming out of a heavy roll and roared, "BILGEWATER ON HOGWASH ABOUT THE GOOD OLD ORIENT." Then he quickly lubricated his hawse pipe from his bottle and added, "Kipling didn't stoke coal below and didn't do business with Chinese when he wrote that stuff".

That did it — stevedores, weather-beaten seafarers, gobs from a nearby destroyer and various landlubbers and waterfront characters put down their glasses. We all fixed our running lights on Marmaduke.

Marmy braced his six-foot-four hulk against the bar, calmly shoved his old gray bowler down by the stern and hooked his anchors into the armpits of his checkered vest.

Barrymore never faced his audience more majestically nor dramatically than this peer of steam engineers. His attitude was—here you see a man—a man who has lived. And by God, you'd better listen when he speaks.

Then satisfied that we were all aboard with him, Marmaduke yanked his throttle wide open and thundered full speed ahead.

"Back in 1889 I was fireroom second engineer on the *S S Karachi*. She was an old freighter with up-and-down engines and six Scotch boilers," bellowed Marmaduke. "Three boilers were single enders and three doubles. The double enders had a common combustion chamber and were fired from both ends.

"Mike Donovan was chief, the cagiest Irishman ever to hold a chief's berth. Donovan took great pride in his profession but had one bad fault—he squeezed pennies so hard he didn't have time to catch dollars.

"We shoved off from Philadelphia one spring morning for the Far East. I had asked Donovan for fifty grate bars getting into Philly the trip before. But he informed me we'd get them in Shanghai this trip because he could save about three dollars apiece.

"Two weeks later at Lisbon, I told him we'd never make time to Shanghai without some new grates, but Donovan said we'd have to.

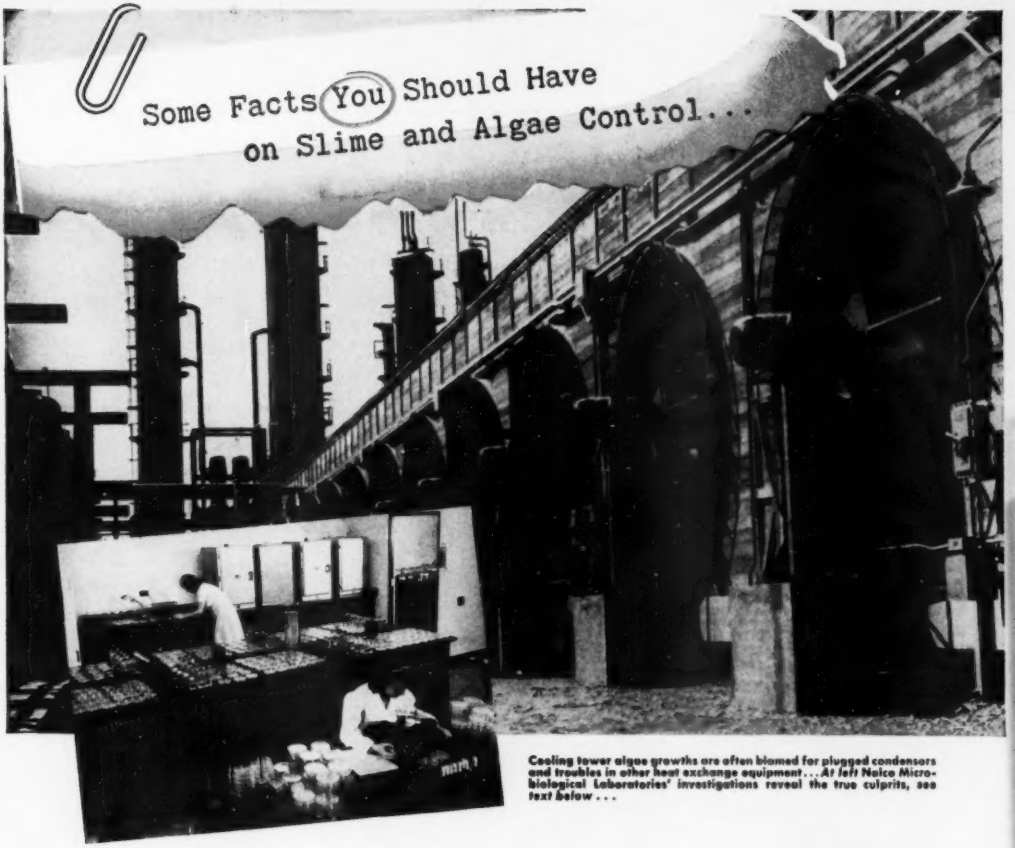
"Many grates were burned badly and warped out of shape. The stokers had trouble burning coal and they squawked plenty.

"We passed Gibraltar, made Marseilles and then Port Said. By that time the stokers were ready to desert. But somehow I kept them in line. They cursed Donovan, the coal and the heat. Pulling out of Port Said I found two stokers had jumped ship.

"Going through Suez and the Red Sea was hell. To make things worse,

(*continued on page* 218)

Some Facts You Should Have on Slime and Algae Control...



Cooling tower algae growths are often blamed for plugged condensers and troubles in other heat exchange equipment... *At left* Nalco Microbiological Laboratories' investigations reveal the true culprits, see *text below* . . .

ALGAE, the trouble-makers in cooling towers, seldom cause plugging, corrosion or iron oxide deposits in other parts of cooling systems . . . Nor can mold growths, slime-forming, sulfate-reducing and iron-depositing bacteria that do cause these internal difficulties be controlled with most algae-killing chemicals.

These established facts make it obvious that proper control of microbiological growths in any cooling system is first a job for experts. Proper identification, selection of treatment chemicals and dosages, and proper points of application will be handled efficiently and economically in your plant by Nalco Field Representatives, working closely with the Nalco Laboratories. Once proper microbiological control is established, consistent supervision to check effectiveness of treatment is all that is necessary to insure clean, slime- and algae-free equipment throughout your cooling system.

Your copy of Nalco Reprint No. 6, "A Practical Approach to the Problem of Cooling-Water Slime," will be sent promptly upon request . . . If your slime and algae control problem requires corrective action, now, write or call for a Nalco Field Representative.

FORMULA FOR SUCCESSFUL SLIME AND ALGAE CONTROL

- Identify slime-forming organisms to be controlled.

A NALCO SERVICE

- Determine the best types of treatment to be used.

A NALCO SERVICE

- Determine, by detailed survey, the proper method of application.

A NALCO SERVICE

- Provide consistent supervision to check application and effectiveness of treatment.

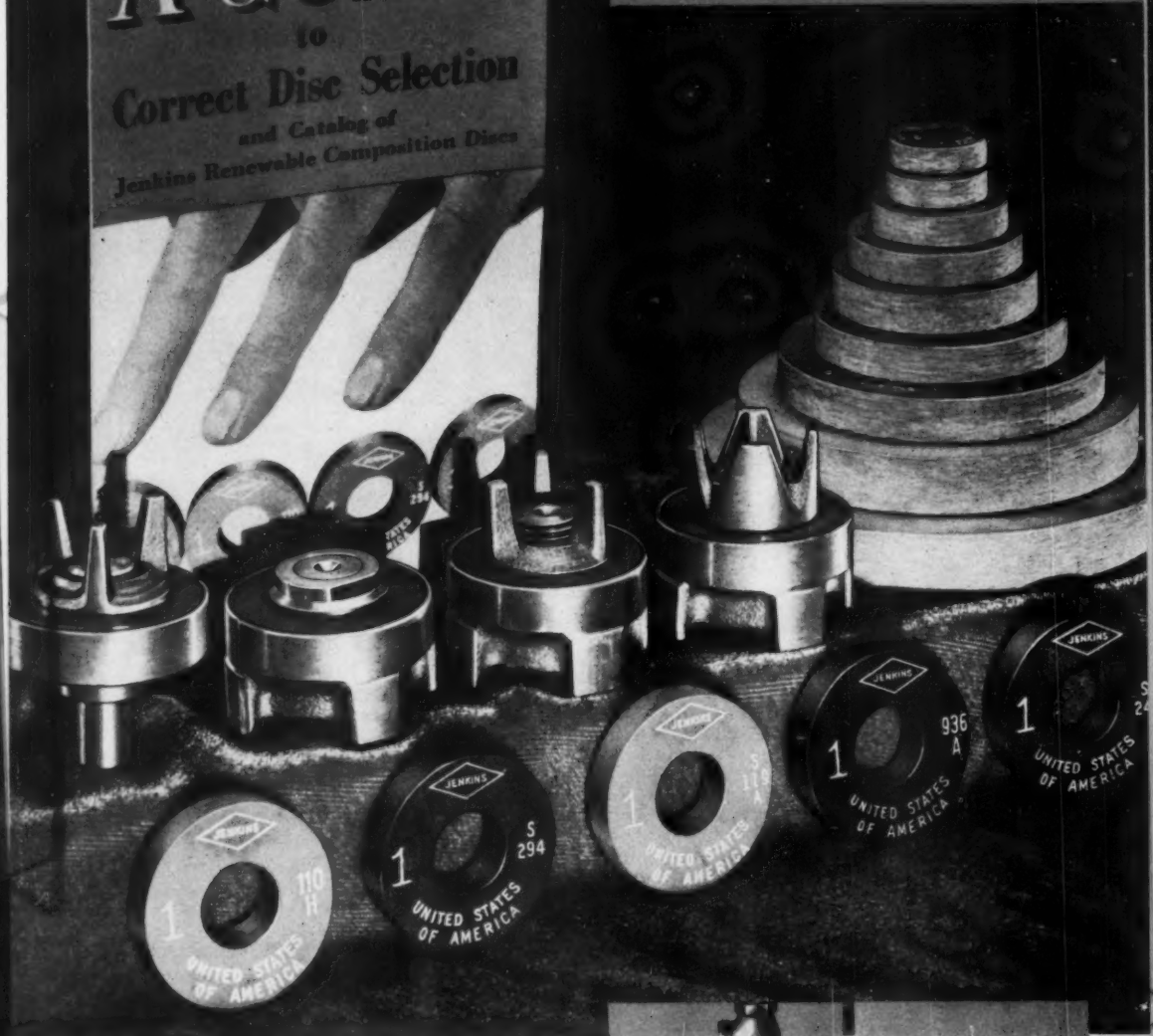
A NALCO SERVICE

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario, Canada

THE *Nalco* **SYSTEM** • **Serving Industry through Practical Applied Science**

A GUIDE to Correct Disc Selection and Catalog of Jenkins Renewable Composition Discs

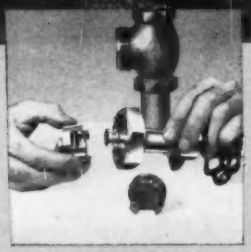
Delivering



The disc holders shown above, fitted with Jenkins Discs, are for Jenkins Check, Globe and Angle Valves. Two have guide disc nuts. One, at extreme right, is fitted with throttling nut.

MONEY-SAVING IDEA FOR VALVE USERS

Maintenance-wise valve users keep on hand a stock of disc holders fitted with the disc most commonly used. This permits quick replacements, saves time.



Maintenance man slips off the disc holder with the old disc, and slips on another containing the new disc.

When he has the time he reloads the old disc holder with a new disc.

continuous valve efficiency...

Jenkins Renewable Composition Discs

Now, when continuous valve efficiency is vital . . . you can rely on readily available Jenkins Renewable Composition Discs to provide the valve protection that greatly extends service life. Proper disc selection and replacement in time guard against premature wear, can multiply the original efficiency of valves many times over.

Disc replacement is simple and easy, can be done without removing valves from the line. To save more time, maintenance-wise valve users keep on hand a stock of disc holders fitted with the disc most commonly used.

Only Jenkins make both Valves and Discs

Originator of the first successful Renewable Composition Disc, Jenkins Bros. has continued to set quality standards. That's why you can rely on your Jenkins Distributor for discs of time-tested design and composition, plus authoritative disc information.

Ask your Jenkins Distributor for the folder, "A Guide to Correct Disc Selection" . . . also the "Jenkins Disc Selector". Jenkins Bros., 100 Park Ave., New York 17. Jenkins Bros., Ltd., Montreal.

Sold through leading Industrial Distributors everywhere.

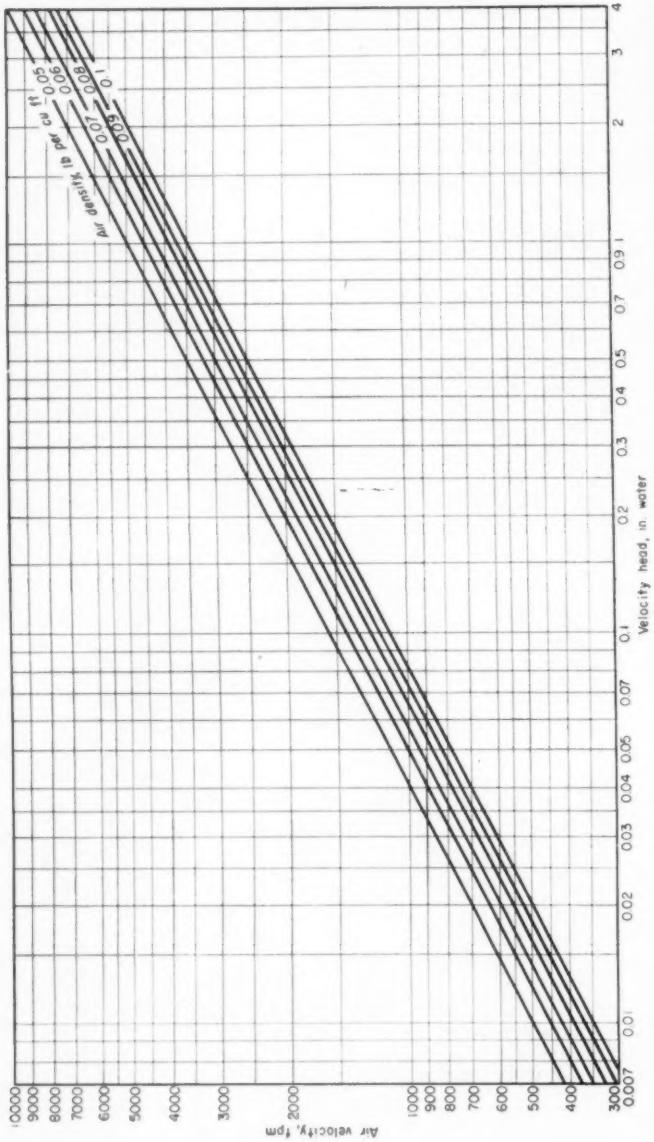
JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros

● Complete information on Jenkins Renewable Composition Discs is contained in the 12-page folder shown at the upper left. The "Jenkins Disc Selector" is a handy, 8½" x 11" wall chart listing recommended discs for all common services, temperatures, and pressures. Both are supplied by Jenkins Distributors on request, to save you time in selection.

Jenkins Discs are made for practically all types of service conditions—for steam, water, air, oil, gas, and chemicals. A variety of rubber composition discs are made for ordinary services, and various special composition and metal discs for such services as superheated steam under high pressure, severe oil service, and other special operating conditions.

POWER'S DATA SHEET

NUMBER 228



Finding Air Velocities In Ducts

► When testing fans and blowers, or adjusting dampers in air-distribution systems the flow velocities must be known. One of the instruments used to find velocity is the pitot tube. With suitable openings in the duct wall the pitot tube can measure velocity pressures at any point in the duct cross section. With the velocity pressure and air density known, the graph can be used to find velocity directly in feet per minute.

Example: For a velocity pressure reading of 1 in. water and an air density of 0.0718 lb per cu ft, find the velocity. Find the 1-in. reading on the horizontal scale and follow up to interpolate between the 0.07 and 0.08 density curves. Opposite 0.072 find 4100 fpm.

Air densities can be found from wet and dry bulb readings and barometric pressures on standard psychrometric charts. If charts are not available use following formulas:

$$p_v = p_g - p_a(t_a - t_w)/2700$$

$$d_a = (p_a - 0.38p_v)/0.754(t_a + 460)$$

$$d_d = d_a \frac{p_a + (p_s/13.6)}{p_a} \cdot \frac{t_a + 460}{t_d + 460}$$

p_v = partial vapor pressure in atmosphere, in. Hg

p_g = saturated vapor pressure at t_w, in. Hg (from steam tables)

p_a = barometric pressure, in. Hg at 32 F

t_a = dry-bulb temperature of atmosphere, F

t_w = wet-bulb temperature of atmosphere, F

d_a = atmospheric density, lb per cu ft

d_d = density of air in duct, lb per cu ft

p_s = static pressure in duct, in. water

t_d = temperature of air in duct, F

JOHN D CONSTANCE
Cliffside Park, N.J.

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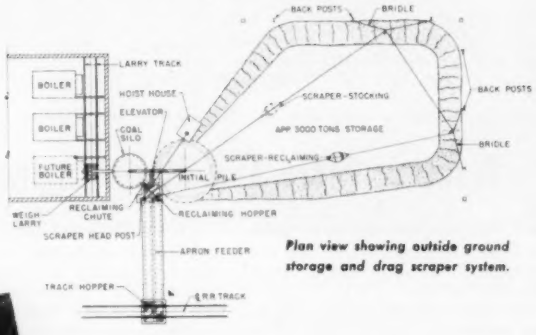
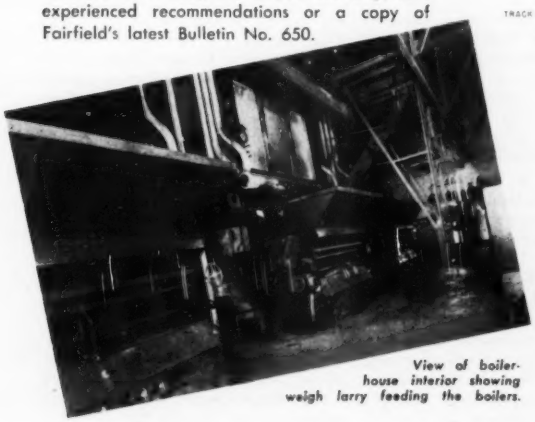
FAIRFIELD SERVING THE NATION'S POWER PLANTS

the complete package

When it comes to coal and ash handling equipment, "the complete package" has special meaning to users of Fairfield systems. Take the installation pictured here, for example. This large Michigan manufacturer turned over his boilerhouse problems to Fairfield Engineers—and received in return, a system economically planned to meet his complete requirements—including 3000-ton ground storage facilities. You, too, can enjoy the advantages of Fairfield's "complete package" planning and construction—either for expansion, or new plant facilities. Write or call today for a Fairfield Engineer's experienced recommendations or a copy of Fairfield's latest Bulletin No. 650.



Plan view showing outside ground storage and drag scraper system.



View of boiler-house interior showing weigh larry feeding the boilers.

FAIRFIELD

The FAIRFIELD ENGINEERING COMPANY

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MARION, OHIO

READER SERVICE SECTION

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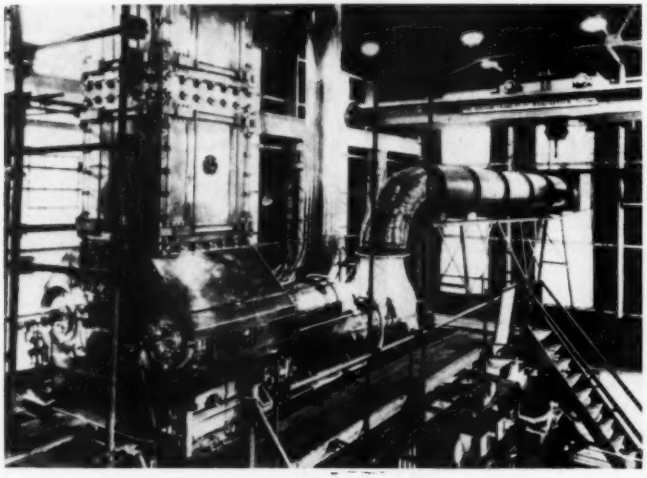
TECHNICAL BRIEFS 158
PLANT EQUIPMENT NEWS 162
NEW FREE BULLETINS 171



Gas Turbine Powers British Tanker

First full-scale gas turbine in the world to be applied to ocean-going shipping shown on its test bed. It will be installed in the *Auris*, an 8221-ton British tanker, and given a shakedown run. Major advantages are its ability to run on heavy and thus cheap fuel, easy maintenance, moderate weight and freedom from vibration

Wanted: More and More Engineers

► ACCORDING TO THE U. S. Bureau of Labor Statistics, the long-term trend in engineering employment is upward. The Bureau says:

"Industry has been using an increasing proportion of engineers in relation to total number of workers employed. As a result, the number of engineers employed has increased rapidly and will continue to grow in the long run even under peacetime conditions. Additional engineers will be needed at an even faster rate for the present defense mobilization.

"Despite record graduation over the last few years, industry is seeking additional personnel, particularly for this defense program. What's more, the number of graduates is expected to drop, mainly because veteran enrollments have declined. Those now planning to enter engineering schools, should find good employment prospects when they finish their courses."

POWER, along with other responsible publications in its field, can echo the above sentiments from first-hand experience. Many of the leading engineering concerns are carrying on active engineer-recruitment programs by every available medium.

One very large concern in the heavy-power-equipment field has worked up an interesting newsletter presentation in which they show their need for technical manpower in the various divisions. They break this down into the following major classes: (1) electrical engineers (2) mechanical engineers (3) metallurgists (4) chemists and (5) physicists. This concern points out that engineers fill 16 of their 29 top-executive spots and hundreds hold high-level staff and supervisory positions.

This shortage is not confined to the larger concerns. One leading instrument manufacturing concern has released a general request for help in the engineering line for their production needs. They make a strong point that their appeal should in no way be interpreted as pirating.

What are the long-range possibilities for satisfying the engineering shortage? A release put out by the Engineering Manpower Commission of the Engineers Joint Council states that more than 30,000 students should be graduated from engineering schools each year to staff the national effort. This is considered a conservative estimate. To achieve it, engineering schools will have to more than double their present enrollment for years to come.

The "mortality" rate in engineering schools runs about 50%. An annual freshman enrollment of 60,000, double the number entering engineering schools this year, would be required to produce 30,000 graduates in a year. The question is, How can twice as many high-school graduates be attracted to engineering schools?

The situation is further aggravated by the expectation that high-school graduations will have declined 10% by 1958. From 2.7 to 3.1% of the total high-school graduating classes have entered engineering schools since 1935, except during the war and immediate postwar years. Of the average high-school output, 60,000 freshman come to 5% of 1,200,000 boys and girls, or about 10% of the boys.

In the words of F C Hollister, dean of the College of Engineering, Cornell University, "There is doubt whether the combined factors of aptitude, ability, interest, can be found in so high a percentage. The fact is that there is not and cannot be developed an inexhaustible supply of engineering talent."

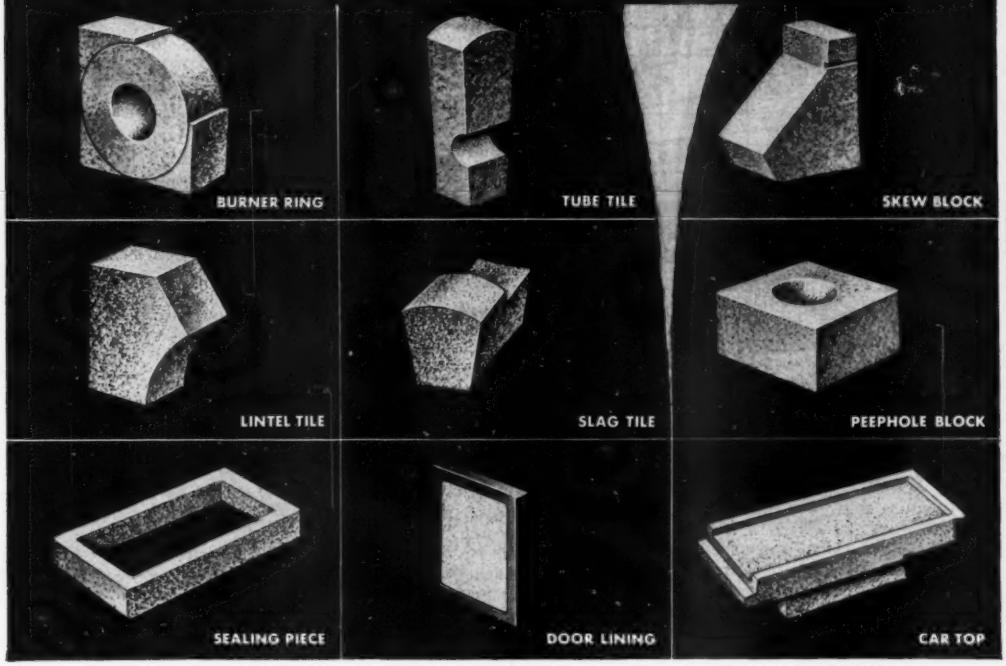
The Engineering Manpower Commission is supplying more than 23,400 high-school principals throughout the nation with leaflets and pamphlets setting forth the facts of the shortage and strongly urging high-school authorities to direct qualified seniors into engineering schools.

FOR MORE NEWS . . .

. . . of the power field, see the items on pp 206-216. Also, Coming Events for this issue appear on page 212; Appointments are on page 236.

Versatile **B&W KAOCAST** *eliminates expensive delays*

WHAT SPECIAL REFRACTORY SHAPES DO YOU NEED QUICKLY?



Special shapes are never special problems if you have B&W Kaocast on hand! With this truly unique, versatile 3000F Refractory Castable they can be molded quickly and easily, *by you, when you need them.* Kaocast can be cast directly in place or applied by cement gun. No expensive inventory is needed for car tops, burner tile, peephole blocks, baffles, bridge walls, door linings, arches, piers and scores of other refractory shapes. You get fast repairs, at less cost.

Kaocast stays on the job, too. It offers high resistance to spalling and slag attack. It has low volume change on initial firing and negligible reheat shrinkage. Thus Kaocast increases furnace availability and decreases production costs.

Put B&W Kaocast to work in your plant. This money saving refractory is another product of B&W's 30 years of specialized refractories engineering. Consult your B&W Refractories Engineer, or write for Bulletin R-22.

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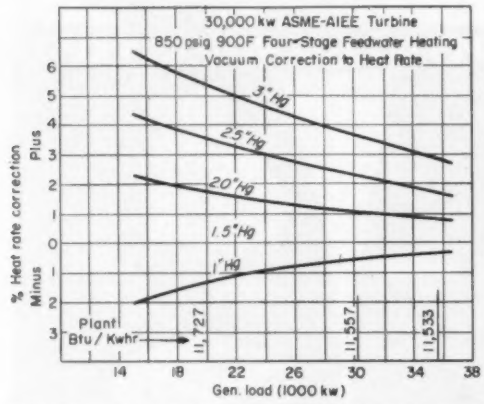
TECHNICAL BRIEFS

Latest engineering developments for busy power men

18 digests for you on:
COOLING TOWERS
STATION DESIGN
FUELS AND FIRING
BOILER AUXILIARIES



Direct comparison of performance, of different combinations of heat exchangers—cooling towers and condensers—under the same heat load and wet-bulb temperatures, fits no formula. But plotting selected combinations helps set correction factors

SUMMARY OF REHEAT INSTALLATIONS

	Jan '46-Jan '50	*Jan '50-March '51*	*Total*
No. of Units	34	82	116
Maximum capability—kw	3,417,500	9,690,000	13,107,500
No. of utility systems	18	24	42
UNIT SIZE			
62,500	5	4	9
75,000	10	13	23
100,000	9	19	28
125,000	3	25	28
150,000	7	17	24
200,000	—	4	4
THROTTLE PRESSURE, PSI			
1250	3	3	6
1450	23	40	63
1800	1	33	34
2000	7	4	11
2300	—	2	2
PRIMARY STEAM TEMP			
950 F	6	3	9
1000 F	20	67	87
1050 F	8	10	18
1100 F	—	2	2

Cooling Towers

SOME ECONOMIC FACTORS IN THE SELECTION OF COOLING TOWERS, *by A R Le Bailly, Sargent & Lundy.* Latent heat of turbine exhaust steam is transferred to the condenser circulating water and later dissipated in the cooling tower. For a specific turbine load the condenser and cooling tower are two heat exchangers operating under the same heat load, water flow, and circulating-water temperature. Their combined characteristics determine condenser vacuum.

There is no practical and simple formula to compare directly the performance of different combinations of condensers and cooling towers operating under the same heat load and wet-bulb temperature. But it is possible by making relatively few performance studies of selected "conden er cooling tower" combinations to calculate respective vacuums and plot them (chart above).

Cooling towers are subject to performance degradation due to age and chemical attack. More recently biological deterioration has been encountered.

A closer approach to maximum normal wet-bulb temperature should be used in design, especially where peak load coincides with a high wet-bulb temperature. *ASME paper No. 51-S-5.*

COOLING TOWERS FOR STEAM-ELECTRIC STATIONS' ECONOMIC APPLICATION, *by Louis Elliott, Ebasco Services, Inc.* It is frequently desirable to draw an economic comparison between direct use of river or pond water for condensing and utilization of cooling towers. Such a comparison for a 60 to 66-megawatt 1250-psig 950-F steam plant, employing 10-year data on river temperatures and records of atmospheric temperature and humidity over a longer period, is presented.

The author develops in a series of steps the factors to consider in such a comparison. River temperature closely follows the dry-bulb air temperature and for practical purposes is assumed equal to it. Water leaving the cooling tower at full load is a few degrees higher than river temperatures in summer and, roughly, 30 deg higher in winter. At half load, in summer, cooling-tower temperature runs slightly lower than river temperature and about 20 deg higher in winter. Comparison results are charted as well as estimates of auxiliary energy use at full and half load. *ASME paper No. 51-S-6.*

Directions for ordering papers are given on page 160

OPERATING EXPERIENCES WITH COOLING TOWERS IN THE CENTRAL GULF AREA, *by H G Hiebeler, Houston Lighting & Power Co.* Large multiple-cell mechanical-draft cooling towers for central-station circulating-water cooling have developed largely within the past decade. During the same time many cooling-tower designs were undergoing considerable change. They were in a process of evolution.

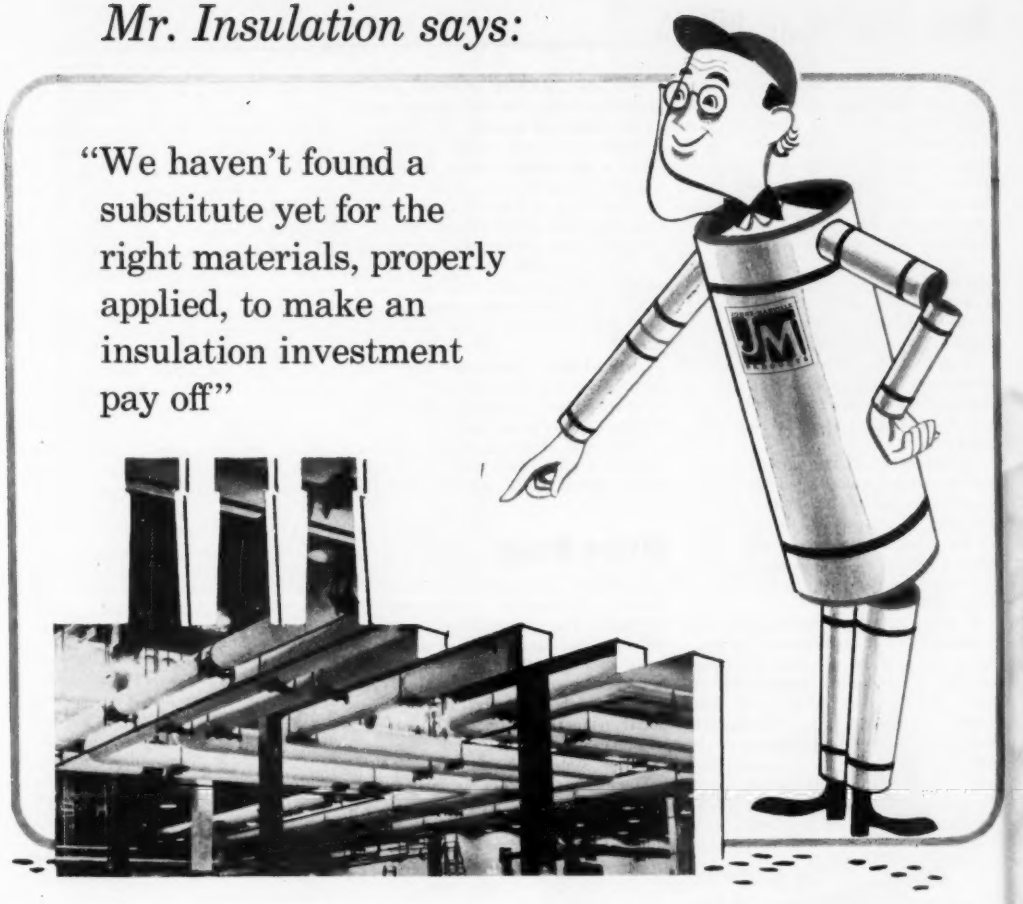
Operating experiences over these years indicated that the reliability of a mechanical-draft tower is essentially the reliability of its fan and fan drive. The motors have a most satisfactory service record. On experience to date, the author's recommendation is for totally enclosed motors.

The fans on forced-draft towers also have a good record. But the author's findings indicated not such a good record for induced-draft fans. But most difficulties with the induced-draft fans occurred very early in their operating life and were mainly due to manufacturing defects. A fan-blade failure is a very upsetting experience to the operator since it can completely wreck a fan and damage its gear. On one occasion, the author describes a blade thrown almost 100 ft from the tower.

Less serious, but quite aggravating, have been numerous oil leaks from the

Mr. Insulation says:

"We haven't found a substitute yet for the right materials, properly applied, to make an insulation investment pay off"



To be successful an insulation job must be properly engineered. In addition, it must have these two important ingredients:

1... THE RIGHT MATERIALS: service conditions vary greatly in industrial applications. That's why no one insulation can serve as a jack-of-all-trades on all jobs. For this reason, Johns-Manville uses asbestos and many other selected raw materials to produce the most complete line of insulations available. These insulations serve applications ranging between the extreme temperatures of 400F below zero to 3000F above.

2... THE RIGHT APPLICATION: Here again Johns-Manville's long experience in the field of insulation can be of value to you. Insulation engineering advice plus the services of insulation contractors trained in Johns-Manville methods of correct application are at your call.

If you are planning an insulation job why not put your problem up to insulation headquarters? Write Johns-Manville, Box 290, New York 16, N. Y.

JM

Johns-Manville *first in* **INSULATIONS**

More TECHNICAL BRIEFS

Begins on page 158

different units. This oil drops directly into the circulating system and hence such leakage cannot be tolerated. The main and larger leaks are at the upper seals at the output shaft and the seals at the input shaft of the driving gear. Substituting a metallic seal has made some improvement, but more is desirable. *ASME paper No. 51-S-9.*

RECIRCULATION IN COOLING TOWER, *by Joseph Lichtenstein, Foster-Wheeler Corp.* After defining recirculation, the paper shows it is a characteristic of a cooling-tower installation and must be considered in economic calculations by user and manufacturer for proper selection in reaching a specified cold-water temperature.

A knowledge of the various factors involved in recirculation with any given installation can only be obtained experimentally by coordinated over-all tests on the actual cooling tower. The paper develops the methods and equations required for such tests to find the recirculation factor.

It shows how cold-water temperature is affected by various degrees of recirculation and how size of cooling tower has to vary if cold-water temperature is fixed. Further, the variation of cold-water temperature with different wet-bulb temperatures is studied to establish a series of fixed recirculation factors. Then if the recirculation factor increases with a dropping wet-bulb temperature, a nearly constant cold-water temperature all year round may result. *ASME paper No. 51-S-8.*

DETERIORATION OF WOOD IN COOLING TOWERS, *by R H Baechler and T A Richards, U. S. Dept of Agriculture, Madison, Wis.* Premature deterioration of wood in a number of cooling towers within several years has brought this problem to focus. The paper is intended to discuss the nature of the wood, kinds of deterioration it may experience, and the condition under which it works in a normal cooling tower. Moisture conditions vary from place to place within a tower. Some parts are submerged in water, while others are dry most of the time. Some parts have a constant flow of water over them while in operation. Wood in these locations reaches and remains at a high moisture content, so decay is less of a problem than chemical attack. But water is highly aerated and even these parts may decay.

Other parts of the tower are bathed in a mist, and because the temperatures are favorable, vulnerable wood may decay. Still other locations experience intermittent splashing or flooding with resulting evaporation and concentration of any chemicals in water.

Redwood is most commonly used in constructing cooling towers. Its principal advantages lie in its inherent resistance to decay and its relative freedom from distortion with changes in moisture compound and content. The heartwood is very susceptible to penetration by liquid under pressures. This last-named quality may have some bearing on its rate of deterioration by chemical solution.

Type of decay found most often is a light pocket rot that commonly occurs in cooling-tower eliminator slats. The surface appears sound and is frequently covered with algae and fungi, but the interior is pitted, soft and, in extreme cases, fibrous. *ASME paper No. 51-S-11.*

Station Design

THE TREND TOWARD REHEAT, *by H G Ebdon, Combustion Engineering-Superheater, Inc.* Reheat offers certain definite advantages: (1) For the same initial steam condition a 4 to 6% gain in cycle economy for large turbines can be had by reheating steam to about the initial temperature and at the most advantageous pressure. (2) Average moisture content of steam during expansion is less and there is an increase in available energy. (3) Because of reduction in steam flow, the condenser, feedwater heater and related piping may be reduced in size to give a smaller investment. (4) Where cooling-water supply is limited the reduced condenser heat rejection of the reheat cycle enables installation of 7½ to 11% more capacity in reheat than in nonreheat units. (5) Regardless of initial steam conditions, the reheat cycle maintains a theoretical advantage over the nonreheat regenerative cycle. (6) A greater inherent efficiency of the reheat cycle contributes to conservation of fuel reserve. (7) With the single boiler-turbine-generator, there is no problem of complexity of operation.

By 1948, the single boiler-turbine-generator had become standard practice and the generally accepted steam cycle was 1250 psig and 950 F. A reduction in net heat rate of about 1000 Btu was obtainable with a reheat cycle at 1450 psig, 1000 F resuperheated to 1000 F. With a steady rise in fuel prices the added cost of reheat could be justified. To date a total postwar addition of 116 reheat units and 12,102,500 kw of capacity table, p 158, have been placed in private utility systems. *MWP paper. No number.*

USE OF DIESEL GENERATING UNITS ON THE NORTHERN STATES POWER CO SYSTEM, *by E F Carlson and H H Rhoades, Northern States Power Co.* In the fall of 1946, this company faced the problem common to most utilities of providing adequate generating capacity for the expected peak loads of 1947. Steam capacity planned for operation would be delayed because of strikes and other factors beyond the company's control.

The company went to 27 diesel units of about 1000 kw each, in groups of two, three or four, spotted in 10 strategically located plants. Fourteen of these diesel units were in service for the 1947 peak load, even though final commitments were not made until February of that year. The diesels provide a direct supply for load in the area in case of line outages, serve as relief for overloaded transmission lines and transformer banks, help solve voltage problems, in addition to being an extra increment to the system capacity. *MWP paper. No number.*

MERCURY-STEAM POWER PLANT *by H N Hackett, General Electric Co.* The continued upward trend of fuel and operating costs is providing an impetus to the electrical power industry for closer study of high-efficiency power cycles. A comparison of mercury and steam plant's net heat rates shows that the 40,000-kw Schiller Station, using moderate pressure and temperature mercury

(*Continued on page 176*)

TO OBTAIN COMPLETE TEXT

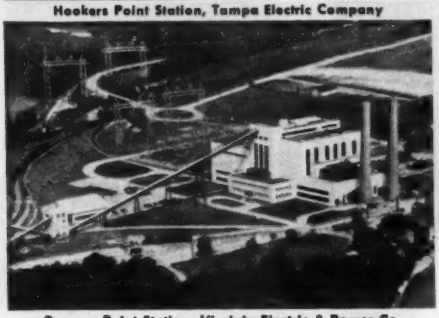
Material for these abstracts comes from one of the following sources. Order complete paper from source, not from POWER.

American Society of Mechanical Engineers, spring meeting, Atlanta Biltmore, Atlanta, Ga. April 2-5, 1951. Identified by initials ASME obtainable through ASME, 29 W 39th St, New York 18, N. Y.

Midwest Power Conference, Sherman Hotel, Chicago, Ill. April 2-5 1951. Identified by initials MWP. Obtainable in procedures. Inquire R A Budenholzer, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill.

Combustion Conference, Univ. of Michigan, March 21-22, 1951. Inquire University of Michigan, Ann Arbor, Mich.

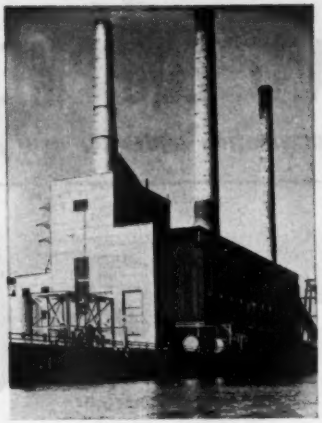
Hookers Point Station, Tampa Electric Company



Possum Point Station, Virginia Electric & Power Co.

Louisiana Station, Gulf States Utilities Company

Venice No. 2 Plant, Union Electric Power Company



Riverside Station,
Savannah Electric & Power Company

Designed & Constructed
by
Stone & Webster
Engineering Corporation
and using

OIC Valves are *precision engineered* and *precision built*. OIC engineers offer you *precision application* help.

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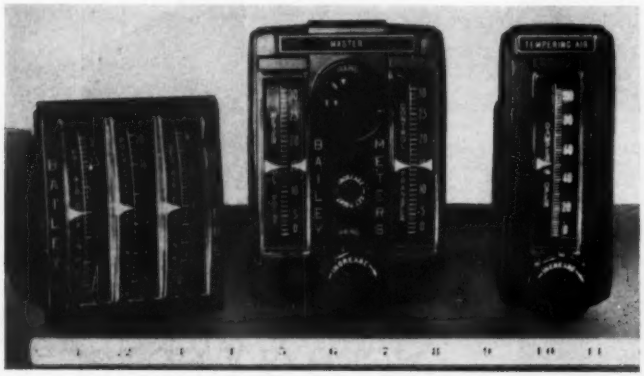
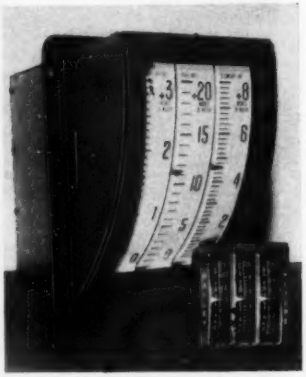


1 Line-up of new meters—the *Mini-Line*, includes a multipoint indicator, *left;* a selector valve, *center;* a remote manual relay, *right*. They cut space 50%



2 *Mini-Line* uses 87% less space than normal for the multipoint indicator

Space-Saving Control-Room Instruments Permit 50% Smaller Benchboard

P600 • As power and process plants have grown larger and more complex the necessary metering and controls have increased. The centralized control board represents an essential step in keeping process controls and indicating devices within reasonable operation. Now comes a notable advance in the form of miniature indicators and controls, Fig. 1, called the *Mini-Line* which cut space requirements by more than half.

These instruments include a multipoint indicator, Fig. 1 and 2, which uses 87% less panel space, a selector valve, Fig. 1, requiring 52% less space and a remote manual relay, Fig. 1, taking up 72% less space.

Recommended mounting for these instruments is a console-type centralized panelboard wherever possible, so space savings can be used to full advantage in a compact assembly. A 3-unit multipoint indicator measures only 4¼ in. wide and 4⅝ in. high, compared to the standard-size instruments of 10⅞ in. on a side.

The *Mini-Line* selector valve (4½ x 6¼ in.) suitable for remote manual or automatic operation of air-operated controls differs from the standard in more than size. It has no reset position for transfer between remote manual and automatic control. Changes can be made instantaneously without disturbing the controlled factor. Two vertical-scale units in the faceplate of the new selector valve provide information for all switching and adjusting operations.

The *Mini-Line* remote manual relay, smaller than the selector valve, above, 2⅝x6¼ in., gives a control over those factors needing only occasional adjustment rather than automatic control.

Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

FIBERGLAS-REINFORCED POLYESTER INSULATION P645

Temperatures of 125 C and greater, extreme overloading, rough mechanical abuse showed *Glastic*, a Fiberglas-polyester laminate insulation in a favorable light. It is being used successfully by Reliance Electric and Engr Co for slot-wedges, field-coil washers and other insulation parts of these heavy-duty motors.

After 200 hr at 150 C, *Glastic* showed improvement in impact and flexural strength and no appreciable change in dielectric strength.

Laminated Plastics Inc, 1823 E 40th St, Cleveland, Ohio.

For more data on these items, use post cards, p171. Identify request with P and number.

SAFETY SIGN P602

Self-adhesive *Quick-Lable* safety signs are printed on extra-strength cotton cloth and coated with silicone plastic to protect them from dirt, grime, moisture and weather. **W E Schneider, W H Brady Co, Dept 393, Chippewa Falls, Wis.**

And Next Month . . .

System of "sound-rating" fluorescent lamp ballasts. Based on accurate measurement of average sound levels produced by certain ballast designs, units are grouped in one of six classifications. These groupings range from *A*—extremely quiet, to *F*—quite audible.

HEAT EXCHANGER P605

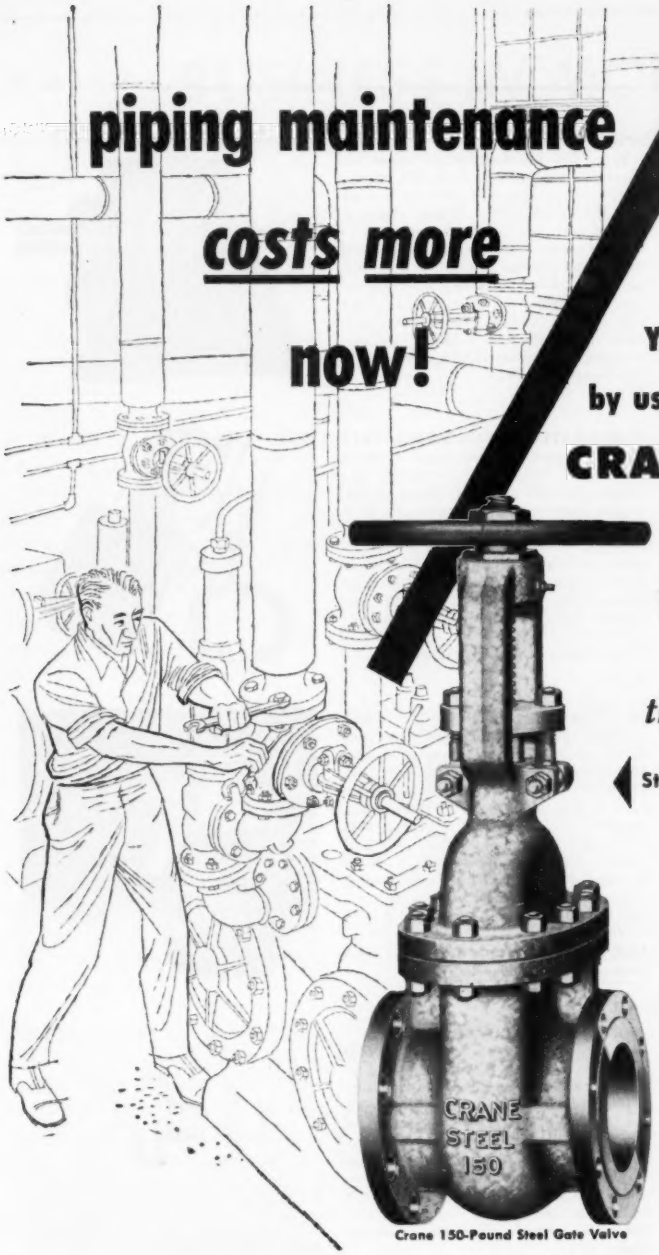
Two-fluid-path produced by a concentric tubing with radial fins gives a heat transfer suitable for a wide range of temperature and pressure requirements. CRF tubing has been made with six radial fins as shown, and in diameters of 1 and 1⅜ in. It can be fabricated of copper, steel, stainless steel, nickel and other metals in lengths up to 20 ft.

Modine Mfg Co, Racine, Wis.

SANITARY HYDRANT P604

Sanitary, nonfreezing, all-weather hydrant has no seep holes. Thus it avoids any danger from ground contamination, and functions properly at static water pressures ranging from 25 to 130 psi and from temperatures extending from + 100 to — 70 F. A special rubber sleeve enclosed in the casing breaks up any frozen water in-

piping maintenance *costs more* now!



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You can practically forget valve maintenance worries with Cran-Cast Steel Wedge Gates. They're unusually rugged . . . amply reinforced at all stress points. Disc is precision-guided to reduce seating surface wear. Straight-through ports give smooth flow, with minimum turbulence and erosion.

Stuffing box depth and design assure tight stem seal . . . long packing life. Valves available in trim materials for steam, water, gas, oil, and oil vapor services.

Ask your Crane Representative about the better quality and greater dependability of Crane valves—your assurance of on-the-job performance that spells lower final cost.

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More EQUIPMENT NEWS

Begins on page 162

side the casing during freezing weather and thus insures operation. A cup-type rubber-seat washer is employed for positive pressure closure and a low friction between sealing parts. Hydrants are available in ¾- and 1-in. sizes and for 2-, 3-, 4-, 5-, 6-, 7-, 8-, or 9-ft depths.

J A Zurn Mfg Co, Erie, Pa.

EMERGENCY LIGHT **P642**

Automatic, emergency hand lamp that plugs into any 110-v ac wall outlet and furnishes instant, automatic emergency lighting when the regular source of current fails. Adjustable 21 cp flood-type head is designed to fit 7½-v battery. Can be manually operated.

Electric Cord Co, 195 William St, New York 38, N. Y.

LAMP LENS **P634**

This instrument combines a 7-power magnifying glass with a light built right into the handle. Unit clearly illuminates the magnified field of vision without throwing direct rays in user's eyes. It is light and portable; accurate inspections can be made even in the darkest corners. It spotlights the work it magnifies.

Housing for the lens system is now made of bakelite plastic to give 75% increase in strength over former models.

Abbeon Supply Co, 58-10 41st Drive, Woodside, N. Y.

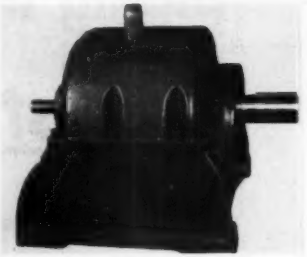
For more data on these items, use post cards, p171. Identify request with P and number.

SPEED REDUCER **P644**

Type DB double-reduction speed reducers, in ratings from 1 to 100 hp, designed for applications on small- to medium-size drives where the prime mover is coupled or belted to the gear unit.

These speed reducers use all-external type helical gearing, arranged in a horizontal plane. When coupled to an electric motor, a straight-line drive results. Eight unit sizes are available; 12 standard gear ratios range from 6.25 to 58.31.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



TEMPERATURE REGULATOR **P614**

Self-contained, tight-closing, ruggedly constructed temperature regulator has clearly marked, calibrated, adjusting dial to give exact setting in degrees F. It is available in two styles, ½ in. through 4. Regulator is completely assembled and requires no linkage or adjustment before or after installation, except the initial simple setting of the control dial to the exact temperature desired. Wiring is 2-wire to 115-v or 230-v ac circuit.

Barber-Colman Co, Rockford, Ill.

pH METER **P615**

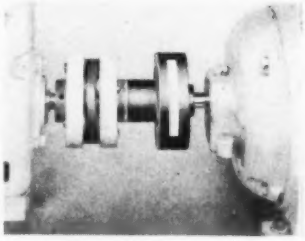
Pocket-size meter, together with companion probe, permits instant on-the-spot pH determination. It is completely self-contained with batteries in a bakelite case, 3x5⅞x2½ inches. The instrument is furnished, camera fashion, in a case with plastic tube containing buffer and KCl solution. Its total weight is 3 lb. Meter is scaled from 2 to 12 for easy reading and a simple adjustment extends the readings from 0 to 14. An accuracy of 0.1 pH is obtainable.

Analytical Measurements, Inc, 585 Main St, Chatham, N. J.

MERCURY-CLUTCH COUPLING **P630**

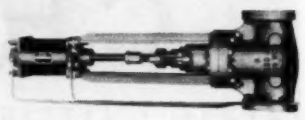
This is a complete unit consisting of a mercury clutch arranged for mounting a standard flexible coupling between it and the driven load. The coupling can be installed on shaft of motors up to 15 hp. The combination of clutch and flexible coupling can connect motor to driven machines without exact alignment. Bulletin No. 113 available.

Automatic Steel Products, Canton, Ohio.



VALVE ACTUATORS **P624**

Designed for operation of gate, plug, diaphragm and butterfly valves, dampers and sluice gates, these units use steam, air, oil, water or gas in actuating cylinder. Actuating fluid pressure may be as low as 15 psi or as high as 750 psi on standard

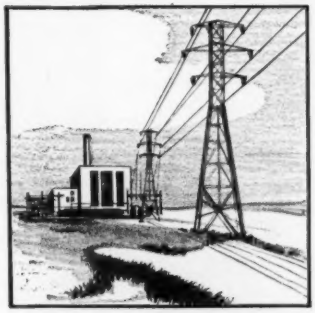


BUSINESS IN MOTION

To our Colleagues in American Business . . .

Like other suppliers, Revere offers its metals in a wide variety of alloys. This is for the reason that no one metal or alloy is suitable for every purpose, for every requirement. In order to help solve the sometimes complex problems that arise concerning metal specification, fabrication, and use, Revere offers the services of its Technical Advisory Staff. Here is an example of its work.

When an electric utility was re-tubing a condenser, Revere Research had an opportunity to obtain samples of the tubes that were removed. A laboratory examination showed them to be made of an excellent alloy; let us call it "Alloy X," since the tubes were made by a competitor. This alloy is usually specified for conditions of erosion-corrosion, but our examination indicated that the tubes also were subject to severe attack by air entrainment and high-velocity, turbulent water. The Revere Technical Advisor, who inspected the condenser in person, suggested that longer tube life might be obtained if cupro-nickel in the 10% nickel alloy were used. As a test, 50 such tubes were installed alongside the new "Alloy X" tubes.



At the end of only three months, the utility was disturbed to find that some of the "Alloy X" tubes were beginning to fail. Samples were sent to Revere Research, which once again reported that these competitive tubes were good ones, mechanically and as to alloy. The Revere Technical Advisor immediately returned to the utility, where he spent two days and nights on the job, much of the time inside the condenser itself. He found the cupro-nickel tubes in fine condition. Recommendations included putting a perforated iron sheet in the water box to reduce turbulence and air entrainment, and the use of 10% cupro-nickel tubes throughout. These suggestions were followed.

Two years later the cupro-nickel tubes were inspected, and found to be in excellent condition. As a result, a new generating station of the company was equipped with them.

Please note our statement that the tubes made by a competitor were all right as tubes. If Revere Tubes in the same alloy had been installed there, the same trouble would have been experienced. It was natural enough for the utility to blame the tubes, but Revere knows that if condenser tubes do not give long and economical service the fault most probably lies in the selection of an alloy unsuitable for operating conditions. In many cases, as in this one, Revere has been able to suggest changes in alloy or in operation, or both, bringing about important economies for users of condensers.

What Revere does in this way is not unique by any means. Suppliers in every industry do as much for their prospects and customers, every day in the week. They do it gladly, because a happy, satisfied customer is a precious asset. So we suggest that no matter what your business is, no matter what you buy, nor from whom, you take your suppliers into the closest possible confidence, permitting them to learn all they can about the conditions their materials have to meet. This will cost you nothing, and may save you much.

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cylinders. Actuators are basically *Ledeen* cylinders equipped with brackets, valves, controls and couplings to make them suitable for almost any operation needed. They are adaptable to all makes, sizes, and types of valves to operate against any line pressure with any fluid and any pressure. They can be arranged for on-and-off service or for positioning service.
Ledeen Mfg Co, 1602 S. San Pedro St, Los Angeles 15, Calif.

ELECTRIC TIMER P633

Type SY *Promatic* timer can be used for all time periods between ½ second and 24 hours. It operates five spdt load contacts independent of time-control circuits. There are two separate solenoids—one operates the clutch and timing mechanism, the other actuates load contacts. Timer automatically resets for each new cycle.

Unit is available for either 115- or 230-v ac. Outside dimensions are 4½ in. wide, 4⅛ in. deep and 8 in. high, including terminal strips.
Product Acceptance Co, 357 Everett St, Boston 34, Mass.

MULTI-CIRCUIT TIMER P640

Multiple-circuit cycle timer for timing laundry and dry-cleaning machinery operations, electrical display signs, industrial furnaces. It may be set for on-and-off periods with as many circuits as desired, and is specially designed for rugged, low-cost service. Unit can be furnished without synchronous motor for elevator control, limit switch and similar applications. Illustrated Bulletin No. 142 gives all details.
Zenith Electric Co, 152 West Walton St, Chicago 10, Ill.

MIDGET ROTARY PUMP P628

With an over-all length of only 3 9/16 in., this pump can be fitted into small space. It is rated 1.65 gpm at 1750 rpm against pressure up to 150 psi. It pumps in either direction of rotation, and bearings do not require oiling. Eccentric pistons made of resilient compounds handle oil, kerosene or viscous fluids.
Eneo Engineering Co, 12 New York Ave, Newark, N.J.

ELECTRIC TACHOMETER P639

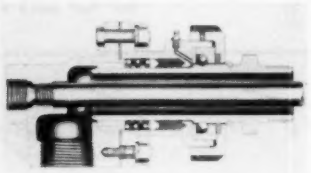
U. S. Varidrive motors are now available with Model R-1 tachometer and generator in ratings from ¼ to 50 hp and speeds from 2 to 10,000 rpm. Tachometer indicator is entirely enclosed to prevent entrance of dust and other foreign particles. It can be mounted at distances up to 300 ft from the *Varidrive* without affecting accuracy.
U.S. Electrical Motors, Inc, 200 East Slauson Ave, Los Angeles 54, Calif.

For more data on these items, use post cards, p171. Identify request with P and number.

AIR DIFFUSER P607

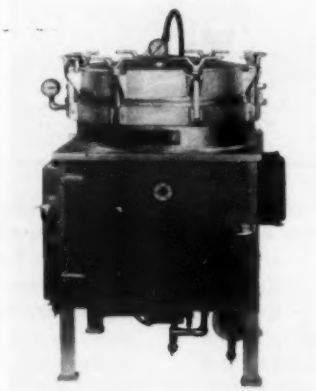
Preinduction type, high-pressure aspirating air diffuser, Type HPW-1, induces room air, mixes it with primary air in about equal proportions, and discharges the mixture. The new unit is available in three sizes, No. 15 with a neck area of 32.8 sq in., 80 to 170 cfm primary air capacity at 0.5 to 2.35 wg static pressure; No. 17½ with a neck area of 42.75 sq in., 105 to 222 cfm at 0.68 to 3.1 wg; No. 20 with neck area of 60 sq in., 145 cfm at 0.7 to 3.2 wg.

These diffusers can be used on air-distribution systems carrying velocities up to 5000 fpm and static pressures up to 6 in. wg; temperature differentials up to 30 F.
Anemostat Corp, 10 E 39th St, New York, N. Y.



REVOLVING JOINT P619

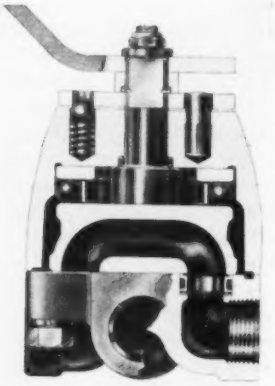
Type IBR revolving joint is designed for making pipe connections to drum-type dryers, rolls, calenders and other rotating equipment. Available for handling steam, oil, air, water, gas and chemicals. Ball bearings carry load of both radial and end thrust. Packing is self-adjusting, self-sealing chevron type. Joint can be serviced without removing from roll. Built for 150-psi steam, 200-psi hydraulic, and for vacuum service. Suited for speeds up to 500 rpm with steam, 750 rpm hydraulic. Top temperature rating is 450 F. Standard sizes run from ½ to 2 in. with a variety of body styles.
Barco Mfg Co, Dept J-40, 1801 Winnemac Ave, Chicago 40, Ill.



OIL RECLAIMER P608

Reclamation of lubricating oil in diesel and gas-engine compressor can be carried out in a new line of oil reclaimers featuring rotary pumps, high-capacity regenerative heat exchangers, vacuum-pump lubricating systems.

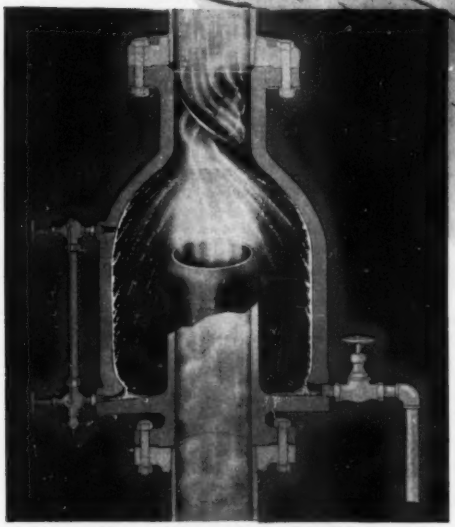
Reclaiming process consists of first filtering oil through a bed of *Hilite* fuller's earth for straight-run mineral oils or *Adstay* filter disks for heavy-duty detergent-type oils. After filtering, the oil flows into a vaporizer to remove all traces of water. From here the oil passes through a high-capacity regenerative heat exchanger for heat rise to the cold incoming oil.
The Hilliard Corp, Elmira, N. Y.



EXTREME-PRESSURE VALVES P623

Pressure-balanced, self-aligning tubular valve seat keeps perfect contact with the mating surface of an optically flat porting disk. Rotary movement of this disk opens and closes the flow passages. When there is no fluid pressure a heavy marcel spring-washer maintains the contact between sealing surfaces, while a predetermined hydraulic force acts on seal under extreme pressure. Fluid flow is always through the hole in the center of the *Shear-Seal*, never across sealing surfaces. Types available are ¾- to 1½-in. shutoff valves for pressures from 0 to 6000 psi; 4-way selector valves from ¼ to 1½ in. for same pressures;

Swartwout helico-centrifugal separators assure 99% dry steam or better—with negligible pressure drop!



1 THE WHIRL DOES THE TRICK! Helix, located near separator inlet, imparts positive whirling motion . . . removes entrained liquids, solids, oil or grease from live or exhaust steam, from air or chemical vapors—*virtually without pressure loss.* Swartwout separators have no baffles, plates, grids or other parts to cause flow reversals, velocity heads or vibration. Vertical separators, above, for up flow or down flow, supplied in 50 to 600 lb. standards.

Swartwout

POWER PLANT EQUIPMENT

2 HORIZONTAL SEPARATORS, built on helico-centrifugal principle, handle any sort of separation with a maximum pressure loss of only a few inches of water under high working pressures or under vacuum. Cast iron for 50, 125, 250 lb. standards; cast steel for 150, 300, 400, 600 lb. standards.

3 EXHAUST HEADS, employing same helico-centrifugal principle as Swartwout separators, remove moisture and oil from exhaust steam . . . prevent rotting of roof and walls in warm weather and ice formation in winter. For exhaust pipes from 1 to 30 inches in diameter. See Bulletin S-16-C.

4 SWARTWOUT AIRFUGE air separator removes impurities by centrifugal force. Simple, float-operated trap releases accumulated liquids automatically while maintaining level sufficient to effect seal. Requires no maintenance except occasional blowdown. Write for special Airfuge Bulletin S-13. A-2909

SEND FOR BULLETIN S-14-C • THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12, OHIO

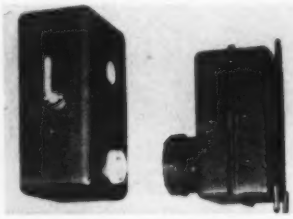
More EQUIPMENT NEWS

Begins on page 162

4-way dual-pressure valves in two classes for: (1) 3000-psi maximum pressure (2) 6000-psi maximum pressure; manipulator valves from ¾ to 1 in. for pressures of 0 to 1500 psi. Service ratings include all common industrial media like water, air, hydraulic oil, gas, fuel and petroleum.
Barksdale Valves, 1566 E. Slauson Ave, Los Angeles, Calif.

OIL-LESS BEARING P636

Graphited oil-less bearings, thrust-washers and bushings are usually installed in remote and inaccessible locations, where fluid lubricants would contaminate work in process, and where high temperatures would oxidize oil. Also suitable where oil films would rupture under heavy static loads, where bearings are immersed in liquids, or where machines must be made as immune as possible to carelessness and neglect.
Bronze Bearings, Inc, 962 North Ave East, Cranford, N. J.



PHOTOELECTRIC ALARM P638

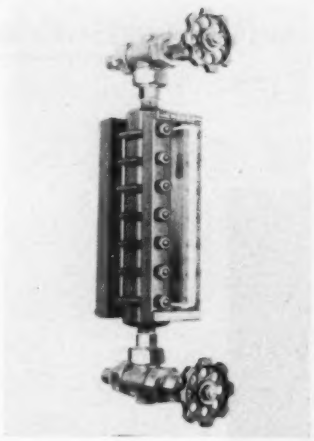
Burglary protection for plants by providing a wall of invisible light across any space up to 50 ft. No intruder can enter this space without setting off alarm.

Alarm set P1A consists of photoelectric control type A20c-2 and light source type L60B. An invisible infrared beam is projected from the light source, spanning any distance up to 50 ft. Momentary interruption of the infrared beams actuates the control relay, which is wired to operate and sustain an external alarm device.
Photoswitch, Inc, 77 Broadway, Cambridge 42, Mass.

AIR-RECOVERY PANEL P613

Readily applied air-recovery panels to fit unit conditioners consist of perforated metal tubes, containing activated carbon held in a rigid frame. They come in a range of sizes, capacities and efficiencies to meet varying requirements. The panels' resistance to air flow is 0.14 in. wg. Their job is to remove offensive odors and make fit for reuse air already conditioned.
W B Connor Engineering Corp, 500 Fifth Ave, New York 18 N. Y.

For more data on these items, use post cards, p171. Identify request with P and number.



LOW-TEMPERATURE GAGES P622

Nonfrosting large-chamber gages are suited for low-temperature ammonia, Freon, propane, ethylene, and other services where low-temperature fluids must be gaged. Gage-glass extension prevents frost forming over vision slot, permitting quick, accurate level reading. Series RLF-10 is reflex; series TLF is transparent. Larger area at the meniscus reduces turbulence. Entire gage, except outer surfaces of nonfrosting window extension, may be insulated.
Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

AIR METER P616

Instantaneous, direct-reading, portable instrument measures air velocity from 0 to 4000 fpm and static air pressures from 0 to 4 in. wg. Instrument has two scales for velocity measurement, a low-range one from 0 to 750 fpm and a high-range from 750 to 4000 fpm.

The air-meter has a self-contained battery for power supply. It operates from a probe-mounted noble metal thermopile placed in the air stream whose velocity is to be measured. A pressure attachment mounts on the probe so pressure can be read directly on the scale on the face of the instrument.
Hastings Instrument Co, Inc, Super Highway at Pine Ave, Hampton, Va.

Now Take Another Minute To Check These . . .

Electrical Tape that's unique for its thinness, electrical resistance, strength and resistance to oils, acids, greases, etc p 178

Plug Valves operated through worm and gear have a port area equivalent to 100% of the area of standard pipe; made in 8, 10 and 12 in. sizes ..... p 180

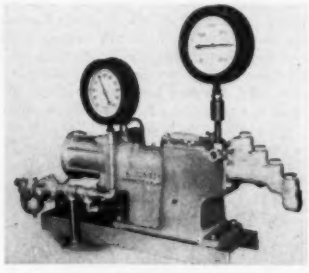
Weatherproof Boxes of cast aluminum. Variety of covers and fittings make them suitable for use on almost any outdoor wiring job ..... p 180

Vertical Pump for general industrial use. Has mechanical seal that adapts it to handling butane, propane, gasoline and other petroleum products ..... p 182

Pipe Coating of asbestos-fiber with asphalt base. Developed for jobs where soil acids or air-borne acids attack pipelines p 184

THREAD COMPOUND P606

Metallic thread compound combines advantages of a lubricant and seals to avoid seizure of pipes, bolts and stud threads, and gasket faces. Known as *Led-Plate*, it has effective results when used in temperatures from — 350 to + 2900 F. The metallic elements, 70% powdered lead, are held in suspension by hydrocarbon.
Armite Laboratories, 6641 Broad St, Los Angeles 1, Calif.



PRESSURE GENERATOR P632

A self-reciprocating pressure generator operating on plant air pressure runs continuously at maximum capacity to build up desired pressure in hydraulic system. When air and hydraulic pressure balance, pump stops. Each pump develops a discharge-pressure ratio range of at least 6 to 1, so a single unit may be used where different test pressures are required.

The pressure generator is used for hydrostatic testing of boilers, forgings, castings, pipe and piping systems, pressure gages, valves, vacuum pumps, hose and other equipment. It fills containers with refrigerants and other liquefied gases, and can be applied as a booster to hold required pres-

(*Continued on page 178*)

For Positive Pressure Control and Lower Operating Costs

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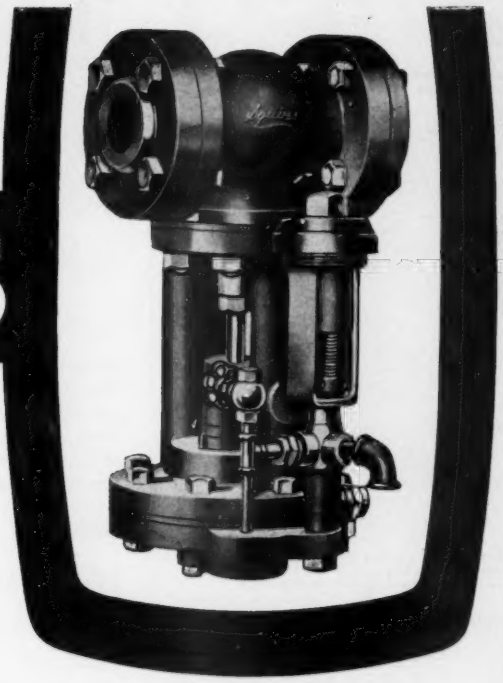
Vertical Reducing VALVES

(FOR STEAM, AIR AND WATER)



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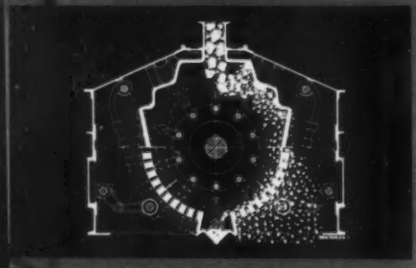
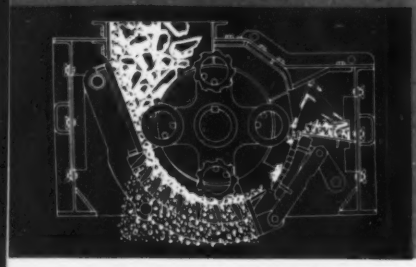
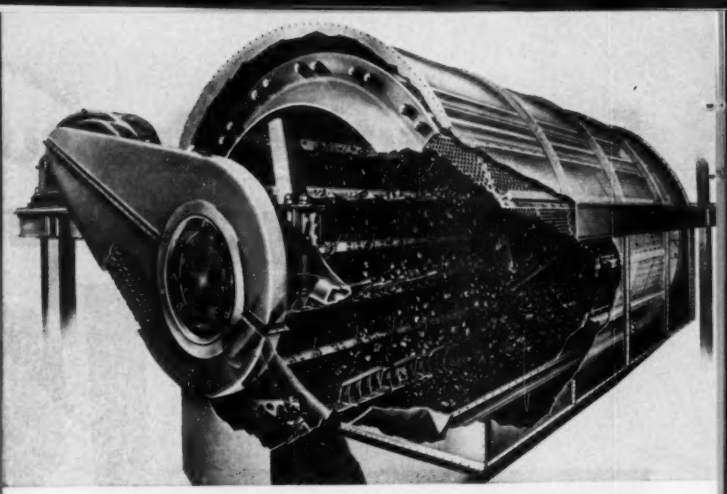


Reversible Hammermill

Ring Type Granulator





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In the majority of central stations throughout the U.S.A. Pennsylvania Bradford Breakers are standard equipment for crushing, sizing and scavenging run-of-mine coal. In approximately 65% of these installations a "stand-by" crusher is not even considered—undisputed proof of the reliance placed on the dependability of a Pennsylvania Bradford Breaker. Ruggedly built, operating at slow speeds and crushing by gravity impact, maintenance costs are practically nil. Send for bulletin 3007.

REVERSIBLE HAMMERMILL—The Ideal Crusher for Preparing CYCLONE BURNER Feed

Reversibility of rotor (by simply pressing a button—today clockwise, tomorrow counterclockwise) means hammers are sharpened automatically—always sharp. This, plus the Adjustable Cage feature, assures a constantly uniform product with very low maintenance cost. The only way to properly obtain and hold the rigid feed specifications required for Cyclone Burner Feed! Ask for bulletin 1040.

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Slow Speed—Low Power Demand—Less Overgrinding—More Granulation, these are the advantages resulting from the improvements on the conventional ring mill principle by Pennsylvania engineers. The "*slow roll*" crushing action is a Pennsylvania patent. Bulletin 9001 gives complete details.

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AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

B1 REFRIGERATION COMPRESSOR—Detailed description of 2, 3, 5, and 7½ hp hermetically sealed refrigeration compressors and condensing units. Bulletin No. 101-110. Westinghouse Electric Corp. Sturtevant Div, 200 Readville St, Hyde Park, Boston 36, Mass.

B2 AIR CONDITIONING EQUIPMENT—Covers equipment needed to do a job of air conditioning: cooling, heating, dehumidifying, cleaning, filtering, circulating; or ventilating; or air handling. 16-page catalog No. SA-6611. Westinghouse Electric Corp. Sturtevant Div, 200 Readville St, Hyde Park, Boston 36, Mass.

BOILERS AND AUXILIARIES

B3 COAL CRUSHERS—Covers complete line of Jeffrey coal crushers for sizing coal to meet the requirements of coal mines, power plants, railroads, industrial and processing plants. Includes features of operation and construction, typical installations. 32-page catalog No. 754-A. Jeffrey Mfg Co, 956 N 4th St, Columbus 16, Ohio.

B4 DUST PRECIPITATORS — Describes latest line of dust precipitators designed to handle fly ash, cinders and industrial dust. Includes operation details, selection data, performance factors, efficiency curves, etc. 12-page bulletin No. 1178. American Blower Corp. Dept D-b, Detroit 32, Michigan.

B5 REFRACTORIES—Discusses machine-made cupola blocks of Kentucky flint and semi-flint clay. Ironton ladle pouring brick and bottom tile are described as practical solutions for foundry problems. Cupola specialties also illustrated. 4-page folder No. 101. Ironton Fire Brick Co, Ironton, Ohio.

CONTROLS, MECHANICAL

B6 PUMP CONTROL—Data on Autocon vault-pump Motetrols, pressure operated pump controls for elevated tank systems with 1 or more pumps. 4-page bulletin No. 1210. Automatic Control Co, 1095 University Ave, St. Paul 4, Minn.

B7 FLAME SCANNER — Describes the Firetron, a fireye that is used with flame-failure safeguards to pro-

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test against the danger of explosion due to flame failure in oil, gas, or pulverized coal-fired furnaces. 4-page bulletin No. CP-611. Combustion Control Corp, 17 Broadway, Cambridge 42, Mass.

B8 TEMPERATURE CONTROL — Lists mercury actuated Thermo-regulators and thermostats which may be selected according to accuracy requirements from plus or minus 0.005 deg C to plus or minus approximately 0.1 deg C. Illustrated with photos and cutaway drawings. 12-page catalog No. 15. H-B Instrument Co, Dept T-51, 3618 Trenton Ave, Philadelphia 34, Pa.

B9 AUTOMATIC CONTROLS — Contains complete coverage of controls for domestic heating applications; controls for various industrial applications; and magnetic and motorized valves. Illustrations show dimensions and prices given on each item. 44-page catalog No. 100. Barnard Corp, 4241 Belmont Ave, Chicago 41, Ill.

ELECTRICAL EQUIPMENT

B10 FAN-COOLED MOTORS — Data on Wagner Type EP and JP polyphase squirrel-cage motors designed for use on applications requiring totally enclosed fan-cooled construction. Built in ratings from 7 to 100 hp. 4-page bulletin No. MU-413. Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo.

B11 POWER TRANSFORMER — Describes application of the OSP power transformer as a completely packaged, single-feeder substation. Available in ratings from 300 to 3,000 kva at high voltages of 15 kv and below, and low voltages of 2301 to 13,200 volts. 16-page bulletin No. B-4441. Westinghouse Electric Corp, Box 1017, Pittsburgh 30, Pa.

B12 INDUCTION MOTORS — Presents a quick summary of the types and features of 2 basic kinds of induction motors—Type CSP squirrel-cage for constant speed drive, and Type CWF wound-rotor motors for adjustable speed drive. 28-page booklet No. B-4789. Westinghouse Electric Corp, Box 1017, Pittsburgh 30, Pa.

★ CIRCUIT BREAKERS—Gives information on a complete line of fully magnetic, non-thermal circuit breakers for general use, auxiliary circuit protection, panel-board applications, etc. 12-page catalog. Heinemann Electric Co, Trenton, N. J. (*Write direct to manufacturer on company stationery giving name and title.)

B13 CALENDER DRIVES—Information on adjustable-speed calender drives for calendering rubber, plastics and similar materials. Includes dimensions and hp ratings, photos, charts and diagrams, and an outline of uses and advantages. 8-page bulletin No. GEA-5208. General Electric Co, Apparatus News Bureau, Schenectady 5, N. Y.

B14 TRANSFORMERS — Gives a complete listing of all capacl, disconnecting, and straight-through potheads. Single-conductor potheads and 14 standard shapes of multiple-conductor potheads are listed in ratings from 600 to 34,500 volts. Installation directions also given. 72-page bulletin No. AB51. G&W Electric Specialty Co, 1700 Dante Ave, Chicago 13, Ill.

B15 MOTOR PROTECTION — Stresses 1-way protection — interlocked protection of circuits, motors, and personnel — for squirrel-cage, synchronous, wound-rotor, and multi-speed motor installations. 12-page booklet No. DB-1471. Westinghouse Electric Corp, Box 1017, Pittsburgh 30, Pa.

HEAT EXCHANGERS

B16 FILM-TYPE HEAT EXCHANGER—Vogt film-type heat exchangers of vertical, single tube-pass design described. Shows typical installations in a chemical, power and compression plant. 8-page bulletin No. 11. Henry Vogt Machine Co, 1000 W Ormsby St, Louisville 10, Ky.

B17 FREON COOLER—Discusses the F-X dry expansion type freon cooler designed for use with water and other fluids for air conditioning, refrigeration, industrial and process cooling applications. Selection data, dimensions, charts and tables are included. 12-page catalog No. 101. Patterson-Kelley Co, Inc, 424 Burson St, East Stroudsburg, Pa.

MAINTENANCE AND SAFETY EQUIPMENT

B18 FUEL OIL TREATMENT — Describes Powersol, a fuel oil conditioner for eliminating tank sludge, cleaning clogged fuel lines and preheaters, reducing carbon at burner nozzles or tips, etc. Also covers Powersol D, a diesel fuel additive. 4-page bulletin. Power Plant Products Co, 98 Federal St, Boston 10, Mass.

B19 CORROSION RESISTANT COATING—Data on "T" Resin, a fluxible prepolymerized furan protective containing no plasticizer. Includes information on characteristics, adherence, colors, application, coverage, prices—Bulletin No. C-52. A summary of 150 corrosion tests on "T" Resin given in accompanying data sheet No. C-52. Carboline Co, 7603 Forsyth Blvd, St. Louis 5, Mo.

B20 CORROSION PROOF STORAGE — Advantages of various types of floating roof tanks, double-deck, pontoon and pan, for product conservation and corrosion resistance are illustrated and described. 8-page bulletin No. 51-F. Hammond Iron Works, 650 Fifth Ave, New York 20, N. Y.

B21 RETAINING RINGS — Engineering specifications and data on a series of retaining rings specially developed to take up end-play and compensate for varying manufacturing tolerances and wear. 16-page bulletin No. 6. Waldes Kohinoor Inc, Truarc Catalog Service, 47-16 Austel Place, Long Island City 1, N. Y.

MAINTENANCE MATERIALS

B22 PACKINGS AND GASKETS — Loose-leaf style catalog describes and illustrates packings and gaskets. Features are: pages of engineering data on causes for packing failure; advantages of latex glands; procedure for installation of packing; recommendations for packing various types of equipment against a long list of services; and a description of Rayton products made of Teflon. 100-page catalog. Raybestos-Manhattan, Inc, Packing Div, Manheim, Pa.

B23 STEAM-DETERGENT CLEANING — Discusses how steam-detergent cleaning saves time and work and helps cut costs in connection with industrial maintenance operations. 7-page folder. Oakite Products, Inc, 128 Thames St, New York 6, N. Y.

B24 FLOOR RESURFACER — Tells about Armor resurfacing and patching material for concrete floors. Features are listed in detail with complete technical information. 4-page bulletin No. C41-L. Monroe Co, Inc, 54198 Quebec Ave, Cleveland 6, Ohio.

B25 ELECTRICAL TAPES — More than 30 uses for four "Scotch" brand electrical tapes for construction and maintenance work are described. Includes photos of applications, and lists properties for each tape. 8-page brochure No. E-CMB. Minnesota Mining & Mfg Co, 900 Fauquier St, St. Paul 6, Minn.

MECHANICAL TRANSMISSION

B26 REVOLVING JOINTS — Presents data on Barco new improved re- (Continued on page 230)

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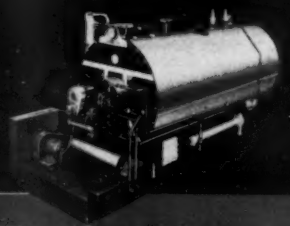
Greater quiet; longer trouble-free operation; cleaner, more healthful atmospheres are other primary results. We can't tell you the whole story here, but you'll find it all in our new catalog. Write today to reserve your copy of the newest edition. Ask for Catalog 301.



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STEAM GENERATORS

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TIMES TOWER, TIMES SQUARE, NEW YORK 18, N. Y.

20th CENTURY MYTH—

"Completely automatic—it never needs attention!"

A few years back I read one of those science-fiction stories that try to depict what this world will be like many centuries from now. Like a great many similar stories, this one predicted a world so completely and automatically run by machines that the people in it did no work—just played.

Only this story took place a little later. The machinery that did man's work had been designed so perfectly, the materials it was made of were so everlasting, that the engineers who designed the machinery and the craftsmen who built it had long since passed away. In fact, nobody alive had used or even seen a hand tool.

But the day came when piece by piece the world's machinery started breaking down. Nobody knew how to fix it, so the Utopian civilization collapsed.

It can't happen here? I think it already has—especially in some of the areas not requiring licensed operators. Today's version runs something like: Install a plant as completely automatic as possible—and then hire just anyone to push the buttons. Of course, I'm exaggerating, but I think you get the idea.

I'm not trying to knock automatic control; it's absolutely necessary to running today's complex plants, and it can save a hell of a lot of money. But like every important scientific advance, with its many advantages, automatic control brings new responsibility to all concerned—plant owner, operating engineer and equipment manufacturer.

Automatically controlled plants require less time and labor to operate and maintain. But they are also highly complex things. And because they're complex, operating these plants takes not semi-skilled workers, who just push buttons according to directions, but trained, intelligent engineers. They must understand the principles and equipment involved well enough to head off the unexpected troubles that can always develop.

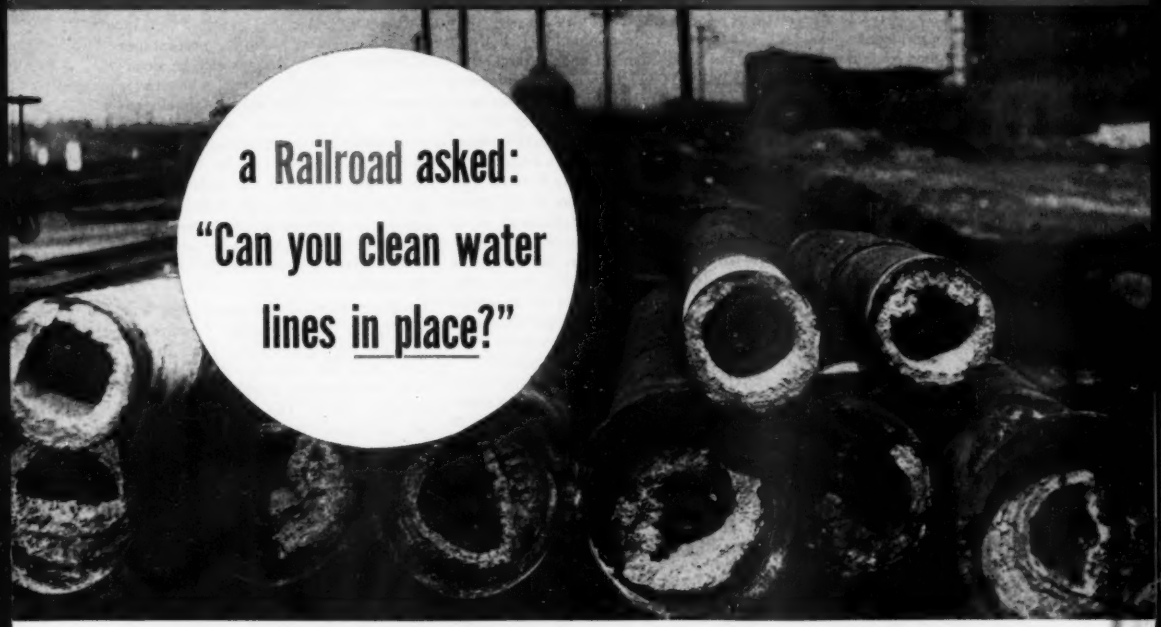
So the way I see it: (1) The plant owners need trained, experienced engineers to protect the investment in their plants. (2) Equipment manufacturers, to protect their own good will and the reputation of their products, should advise their customers that, while their machinery may be easy to operate and maintain, it still needs intelligent operation and maintenance. (3) We engineers owe it to ourselves to keep ahead of our plants if we hope to keep ahead in our jobs.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



Dowell Service cleaned over 8600 feet of buried water line in six days!

You don't have to dig up water lines in order to clean them! Take the case of a major railroad that had over 8600 feet of *buried* water lines, ranging from 2 to 12 inches in diameter. The capacity of these lines had been greatly reduced by scale deposits. Dowell Service cleaned all the lines, *in place*, in only six days with a minimum interruption in service.

Dowell Service offers *fast*, effective cleaning of pipelines—underground or above, indoors or out. No digging or dismantling is necessary. Dowell liquid solvents, designed to dissolve the accumulated deposits, are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water flow, cleaning places inaccessible to other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job, using Dowell-designed, truck-mounted pumps, mixers and control equipment.

Many other types of equipment can also be cleaned efficiently, economically by Dowell Service. If you have boilers, condensers, evaporators, bubble towers, water wells or other operating equipment where deposits are reducing capacity, let *Dowell Service save you time and money* in maintenance cleaning!

Other recent Dowell jobs:

Water well cleaned for large utility. Original production of 1150 gpm had dropped to 550 gpm. Dowell Service brought production back to 1100 gpm.

★

Boiler cleaned for steel company. Steam production before Dowell Service: 115,000 p.p.h.; steam production after Dowell Service: 145,000 p.p.h.

★

Air cooling system on two 22,500 K.W. generators cleaned for Midwestern Utility company in four hours. Before Dowell Service, the operating temperature of the generator was at the maximum allowable of 60° C. After service, the temperature was a normal 50° C.

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Begins on page 158

steam-generating equipment, has a plant net heat rate that compares favorably with 100,000-kw Sewaren units and 125,000-kw Philip Sporn No. 1 installation. *ASME paper. No. 51-S-12.*

POWER GENERATION BY GAS TURBINES *by A G Mellor, General Electric Co.* The combustion gas turbine has now developed to where it can be applied in the power-generation field as an alternate to older established prime-mover installations. Operating and application experience is still limited. This paper points out some of the differences between gas turbines and other types of generation stations. It makes some economic comparisons between the different types of generation and indicates the most probable fields of application for gas turbines in generating electric power.

Gas turbines that are normally operated on bunker-C oil must be started and shut down with diesel oil. For such units, therefore, a diesel fuel system, as well as a bunker-C system, must be put in. The bunker-C oil needs to be heated and centrifuged before delivery to the gas-turbine-driven fuel pump. The fuel system for a gas-fired gas-turbine station is much simpler than for an oil-fired station. All that is needed is a pressure-regulating valve and possibly a fuel gas compressor if fuel is not available at a high enough pressure for a gas turbine.

A reliable source of auxiliary power should be available for starting gas-turbine units. Usually it can be obtained from the power system. In a few cases it may be necessary to provide an engine-driven generator to supply starting power and station auxiliary power. *MWP paper. No number.*

Fuels and Firing

FUEL AVAILABILITY AND ITS INFLUENCE ON BOILERS AND BURNING EQUIPMENT, *by P R Loughin, Babcock & Wilcox Co.* Developments of recent years have brought about the practice of providing boilers and fuel-burning equipment to accommodate a much greater diversity of fuels and fuel quality. But there is no installation that operates satisfactorily with all fuels. So predictions of fuels to be burned during the life of boiler equipment is of utmost importance in its proper selection.

Fuels in general have shown a progressively lower quality. For coal, this is due principally to (1) depletion of the higher-quality seams and diversion of others to coke production (2) greater use of mechanical underground mining methods (3) increased strip-mining operations. For oil, usual practice is to produce a product to meet the several U.S. Bureau of Standards specifications. They have been revised as required to meet changes in supplying demand, and further changes will no doubt come from time to time. Production of heavy fuel oils in this country has been only 85 to 88% of demand, so the difference is made up with imported heavy oils. Because of the blending at refineries and in distribution, it is not often possible to count on receiving a given quality of oil over an extended period.

Quite apart from the normal fuels are the former waste or byproduct fuels. Several factors are forcing their use to a greater and greater extent. Among the more prominent are increases in fuel and labor cost and to a lesser degree more stringent stream-pollution laws, so burning becomes more and more attractive as a means of disposal.

This paper outlines some properties of the various fuels, including natural gas, and shows a few applications where fuels of widely varying characteristics are burned in the same unit. The problems involved and fuel properties are discussed. *ASME paper No. 51-F-17.*

METHOD OF ESTIMATING THE ULTIMATE ANALYSIS OF BITUMINOUS COALS FROM THE PROXIMATE ANALYSIS, *by E W Jerger and J R May, Iowa State College.* Conversion of a proximate analysis of coal to an ultimate analysis. The proximate analysis breaks down coal into four parts, noncombustible water and ash, combustible volatile matter, and so-called fixed carbon. The last two are actually the portion of coal that burns as gas and solid, respectively.

The ultimate analysis gives the chemical constituents of coal, that is, carbon, sulfur, nitrogen, hydrogen, oxygen (water), mineral ash. The proximate analysis can be readily determined with little equipment and comparatively unskilled personnel. The ultimate requires a trained chemist, so the method of getting the latter from the former has obvious advantages.

Equations are given in the paper for finding the heating value of coal from the proximate analysis if the heating value cannot be determined directly. From the heating value the percentages of carbon and hydrogen can be determined. Amount of free moisture is taken directly from the proximate analysis. The nitrogen calculated as a percentage of the combustible of the proximate analysis can be ash or the proximate corrected for sulfur content by a method which gives, in the author's opinion, a more accurate representation than the current practice to use proximate analysis ash directly. *MWP paper. No number.*

DEVELOPMENTS IN SPREADER FIRING WET WOOD, *by A S Weigel, Combustion Engineering-Superheater, Inc.* In recent years the spreader stoker has become increasingly popular for burning cellulose fuels. The same characteristic that gave the stoker flexibility in burning coal is proving equally effective in broadening the spreader-stoker applications to include wet wood.

A number of installations of this firing method for handling wet wood are already in operation. They are (1) indicating advantages of low maintenance and operating cost (2) ability to accurately control fuel-air ratio (which allows applications of automatic control) (3) rapid response to load demands as well as high heat release and practically continuous boiler availability.

When the wet wood is properly sized, this spreader-stoker firing method can handle a moisture content up to 60% and the stoker bed can be either the continuous-discharge or dumping-grate type. It has been applied to existing boilers as well as to new installations. The wet wood can be burned in conjunction with gas, oil or coal. Major problems have been in delivery of wet fuel to the furnace proper. Once there, the fuel-distributor unit can be set at the conventional height above the grate or well up in a high furnace for high heat release and steam rate. *ASME paper. No number.*

SOME COMBUSTION PROBLEMS WHEN BURNING HEAVY INDUSTRIAL FUEL OIL, *by O F Campbell, Sinclair Refining Co.* Successful burning of heavy industrial fuel oil depends to a large extent on the kind of fuel-oil system delivering oil to the burner. Purpose of this paper is to discuss some of the difficulties faced in such a fuel-oil system and to indicate possible solution.

The author suggests as short a suction line as possible and where that is not possible, a larger-size line to compensate for the distance. Further, the storage tank should be insulated to reduce

(*Continued on page* 192)

Directions for ordering papers are given on page 160

FREE

From Western Precipitation—the organization that pioneered the commercial application of Cottrell Precipitation...

28 PAGES of helpful facts to know about COTTRELL ELECTRICAL PRECIPITATORS

IF YOU ARE ENGAGED in any phase of industry where the recovery of dusts, fumes, fly ash, mists, fogs or other suspensions from gases is a problem, you will find this booklet on the COTTRELL Electrical Precipitator helpful and informative.

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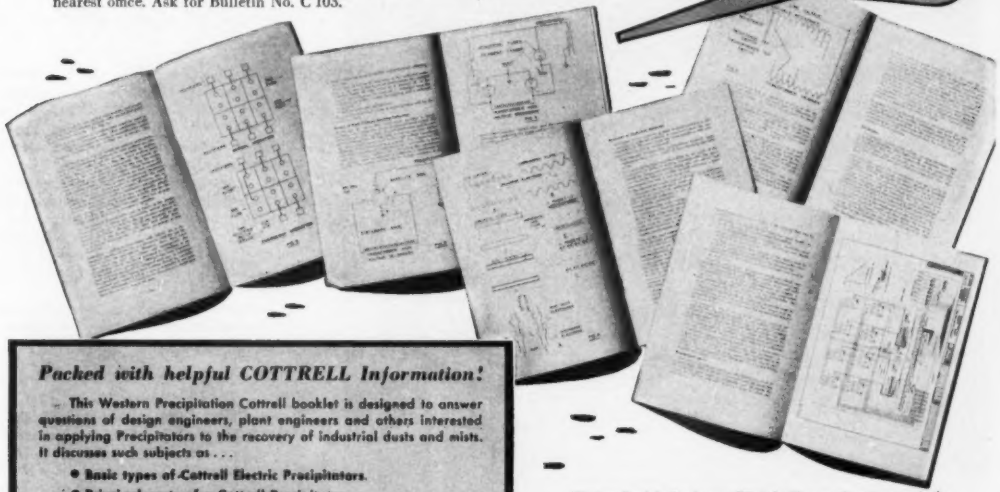
This 28 page booklet summarizes many of the basic facts you should know about modern COTTRELL Precipitators—the various types available, how they operate, principal types of electrode systems and rectifiers, shell constructions, etc. As long as the supply lasts, a free copy will be sent you on request to our nearest office. Ask for Bulletin No. C 103.



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. . . and many other basic Cottrell facts. Write for your free copy of Bulletin C103 today while supplies are adequate!

Western Precipitation is not affiliated with any other company in the field of electrical precipitation except its wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. Whether you are now contemplating the installation of a Cottrell Electrical Precipitator, or may be interested in such an installation at a future date, we can and will serve you in any part of the United States or other countries.

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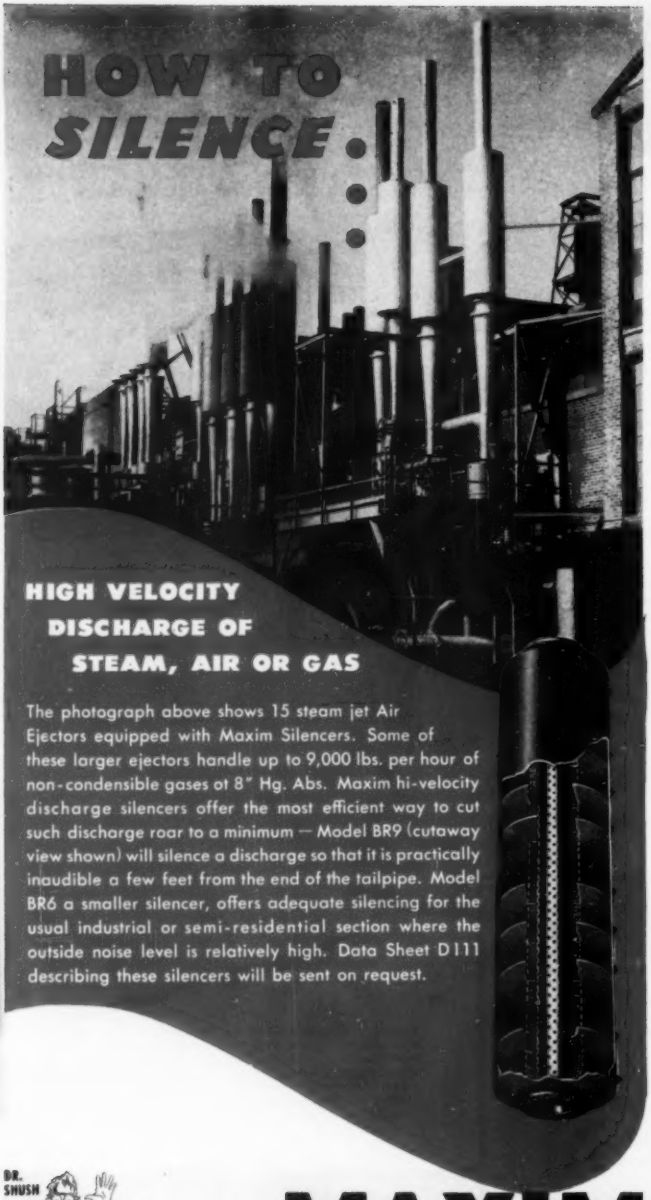

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Consult MAXIM

THE MAXIM SILENCER COMPANY 92 HOMESTEAD AVE., HARTFORD 1, CONNECTICUT

Gentlemen: Please send for bulletin on High Velocity Discharge Silencer

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COMPANY _____

ADDRESS _____

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RMVR1

More EQUIPMENT NEWS

Begins on page 162

sure in hydraulic systems. Capacities range from 4 to 405 gph and pressures from 25 to 25,000 psi with ordinary plant air pressure. Generator can be had on a portable dolly that takes it to the job.
Milton Roy Co, 1302 E. Mermaid Lane, Philadelphia 18, Pa.

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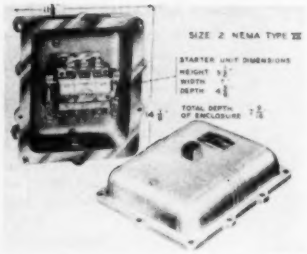


MAGNETIC STARTER **P637**

Explosion- and weather-proof magnetic starters available in sizes 0, 1, 2, 3 and 4 for a wide variety of uses. Typical applications are found with manufacturers of chemicals, explosives, fertilizers, soaps, paints, papers, petroleum, pharmaceuticals, plastics, rubber, textiles, and in processing plants for woodworking, grain milling, etc.

Terminal and contacts are accessible from the front. Line and load may be completely separated, circuits immediately identified.
Arrow-Hart & Hegeman Electric Co, 103 Hawthorn St, Hartford 6, Conn.

ELECTRICAL TAPE **P635**

Vinyl electricians' tape is unique for its thinness, electrical resistance, high stretch, high strength, and resistance to oils, acids, greases, gasoline and alkalies and antifreeze compounds. Known as *Permacel 29 Vinyl Electricians' Tape*, it is of 7 mils thickness, with insulation resistance of 38,000 megohms at 91% relative humidity and 67,000 megohms at 96% relative humidity. Tape will do the work of both bulky rubber tape and friction tape in splicing wires.
Industrial Tape Corp, New Brunswick, N. J.

FLOW INTERLOCK **P612**

New design includes a finer differential, union fitting at both ends, a bronze piston, reduced size and weight, simpler adjustment, and more wiring space for the improved flow interlock. This device responds to a flow of water to open or close an electrical contact. As the water exceeds a preset amount the device closes a contact, and opens it when the flow falls below that amount. In effect, the interlock acts like a fuse in an electric circuit and depends

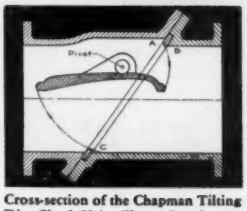
Stop Expensive Slamming With the Cushioned Closing of CHAPMAN TILTING DISC Check Valves

Those words — *cushioned closing* — best describe the action of this unique check valve. The tilting disc works with the stream—opens easily, closes quickly, *yet quietly.* There's no slamming — no resultant destructive stresses on the pipeline.

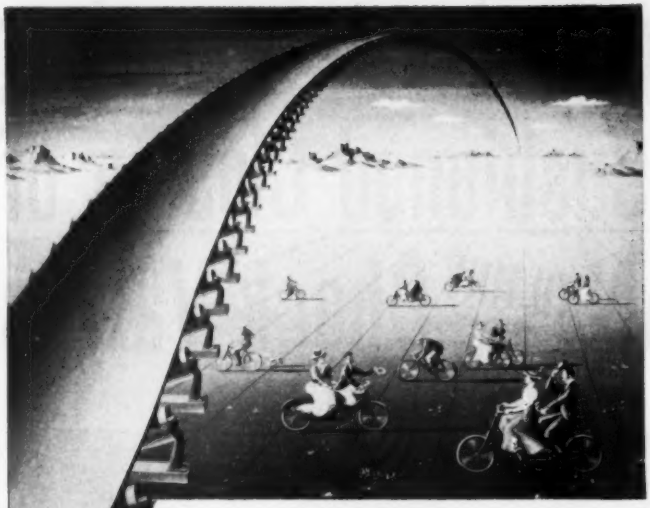
As a result of this smooth, *cushioned action*, maintenance costs are at a minimum and savings of from 65% to 80% in head losses can be obtained over conventional-type check valves.

Send today for the bulletin describing this unusual valve.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.



MILLION-MILE IDEA FROM WATCHING THE BIKES GO BY

From the way bicycle tires resisted the abrasion of cobblestone roads came an invention which is now an essential lifeline of the American industrial economy.

It was in 1891 that Thomas Robins first covered a conveyor belt with rubber and proved it tougher than steel when handling heavy bulk materials.

The rubber-covered belt is but one of scores of "firsts" to come from Hewitt-Robins . . . in belting, in hose, in machinery—in *better ways* to handle and process solid or fluid bulk materials.

Today you get still another "first" when you turn to Hewitt-Robins for belt conveyors. You get the *complete* job. Hewitt-Robins is the first and only organization in the world that supplies engineering, specialized machinery *and belting* from within its own corporate structure. Hewitt-Robins alone is able to take undivided responsibility from drawing board to production run.

Our three industrial Divisions work individually or as a team, depending upon the problem and your need. Next time materials handling is *your* problem, we invite you to make it *ours*.

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Executive Offices: 370 Lexington Avenue, New York 17, N. Y.

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ROBINS CONVEYORS DIVISION: Conveying, screening, sizing, processing and dewatering machinery

ROBINS ENGINEERS DIVISION: Designing and engineering of materials handling systems

Hewitt-Robins is participating in the management and financing of Kentucky Synthetic Rubber Corporation

More EQUIPMENT NEWS

Begins on page 162

upon watercooling for protection. It can be used as a safety device for welding units, transformer coolers, watercooled dynamometers

General Electric Co, Schenectady 5, N. Y.

For more data on these items, use post cards, p171. Identify request with P and number.

WORM-AND-GEAR OPERATED PLUG VALVES P625

Identified as Fig. 502 GW these plug valves have port area equivalent to 100% of the area of standard pipe, are cast in semi-steel and made in 8, 10 and 12 in. sizes. They have been added to the line of lubricated plug valves. They will also soon be available in cast-steel full-port type known as Fig. 562 GW and in venturi-type sizes up to 14 in. In venturi type these valves will have same face-to-face dimensions as like-sized series 15 wedge-gate valves. They will be designated Fig. 512 GW for semi-steel, Fig. 572 GW for steel.

Homestead Valve Mfg Co, PO Box 550, Coraopolis, Pa.

WEATHERPROOF BOXES P643

Heavy-duty weatherproof junction boxes made of noncorrosive cast aluminum include a variety of covers and fittings for universal use on almost any outdoor wiring or lighting job. Box itself has four ½-in. hubs tapped, which are provided with or without mounting lugs. A flat aluminum cover plate is sealed with a heavy cork gasket and a separate cast aluminum cover. Standard lamp holder takes 150-, 200- and 300-watt outdoor weatherproof reflector bulbs.

Stone Manufacturing Co, 489 Henry St, Elizabeth 4, N. J.

CABLE ENTRANCE-SEAL P641

Type RS cable entrance-seal uses bushings of *Resistoyl* rubber material compressed in a stuffing box to form a pres-

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Get TWICE the value for your steam trap dollar!

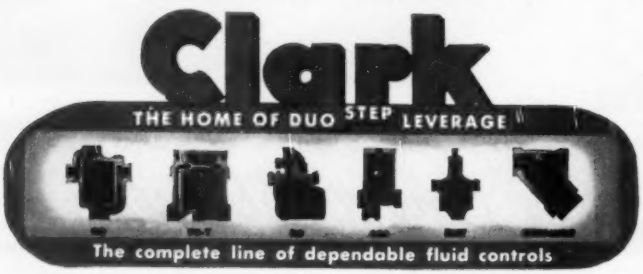
Just as the self-starter revolutionized the automobile, so Clark Duo-Step Leverage is changing old-fashioned ideas about steam trap efficiency.

Field and laboratory tests prove that Clark DUO-STEP Steam Traps more than *double* the drainage capacity of ordinary inverted bucket traps.

Ask your Clark representative for a demonstration on your steam lines—or write us for complete information.

Here's how DUO-STEP doubles drainage capacity

THE CLARK MANUFACTURING COMPANY
1831 East 38th St. • Cleveland 14, Ohio



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Begins on page 162

sure-tight, oil- and moisture-proof seal on all types of leaded and non-leaded cables. Bushings of *Resistoyl* are held between metal disks and compressed by tightening a gland nut.

Fittings for use with conduit and wire or tape armor are available for the RS cable entrance. A full description of this new cable entrance-seal is given in *G & W Forethought E3-16.*

G & W Electric Specialty Co, 7780 Dante Ave, Chicago 19, Ill.

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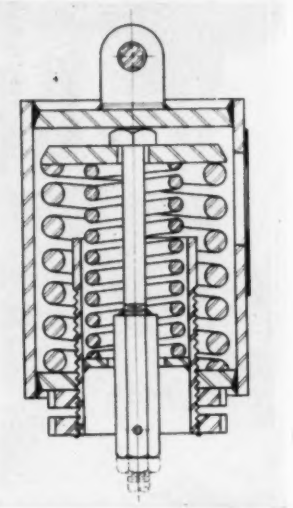

VARIABLE-SUPPORT HANGERS P620

Nonresonant variable-support hanger has two helical springs in parallel that prevent a resonant amplitude regardless of the impressed frequency. Outer or load spring supports entire weight of pipe at all times. Inner or snubber spring functions only when vibration occurs. Without vibration, snubber is unloaded. But with the slightest vibration it is loaded intermittently, changing the stiffness of the hanger with each half-cycle of vibration and preventing development of a resonant amplitude. Available in 1½- and 3-in. travel ranges with several different types of attachment. Installation is simple and adjustments are quickly made from outside hanger.

Bergen Genspring Corp, 15 Park Row, New York 7, N.Y.

VERTICAL PUMP P629

This pump for general industrial use has a mechanical seal that adapts it to handling butane, propane, gasoline and other petroleum products. It is a small standard ver-

TIMKEN® bearings help make light work of 10,000 lbs. of auto frame bars

THIS Ross series 70 straddle carrier, shown in operation at the A. O. Smith Corporation, Milwaukee, transports auto frame bars often weighing as much as 10,000 lbs. And it stays on the job day after day with Timken® tapered roller bearings in the wheels, pinion, and differential.

Because Timken bearing rollers and races have a case-hardened outer surface and a tough core, they give long wear under the hardest service. The tapered construction of Timken bearings enables them to take radial and thrust loads or any combination. They have *extra* load-carrying capacity, too, because of line contact between rollers and races.

Since Timken bearings hold shafts in proper alignment, gears mesh accurately. Wear on adjacent parts is reduced and a smooth flow of power assured. Tighter lubricant-retaining closures are permitted; damaging dirt and grit are kept out.

The incredibly smooth surface finish and true rolling motion of Timken bearings practically eliminate friction. Because they're precision manufactured, engineered for the job, and made of Timken fine alloy steel, they normally last the life of the machine.

Backed by over half a century of bearing research and development, Timken bearings are first choice throughout industry. Make sure you specify Timken bearings for the machinery you build or buy. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

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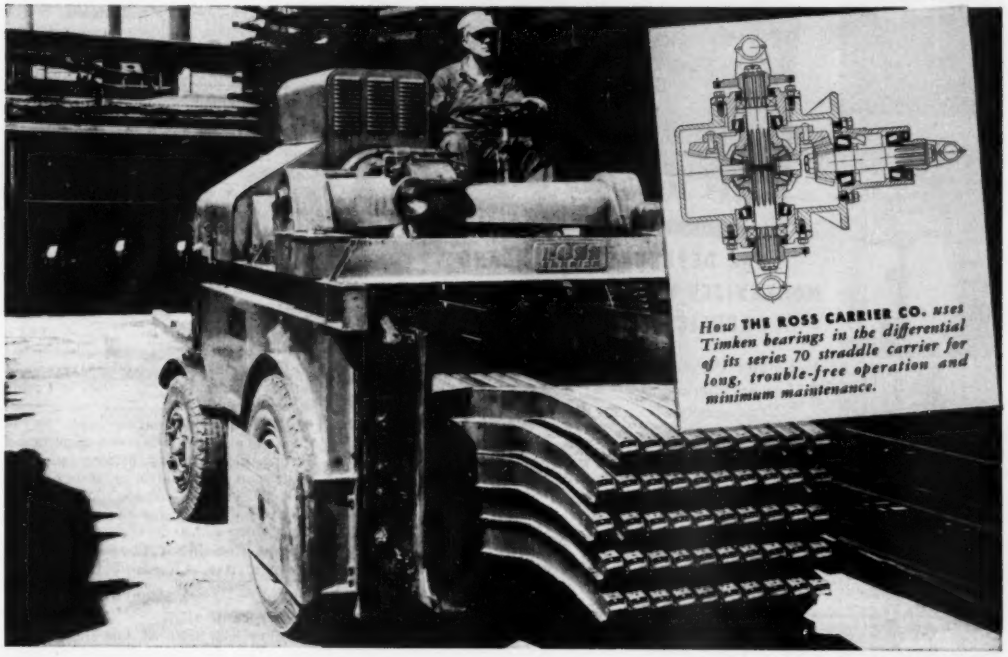

How **THE ROSS CARRIER CO.** *uses Timken bearings in the differential of its series 70 straddle carrier for long, trouble-free operation and minimum maintenance.*

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Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

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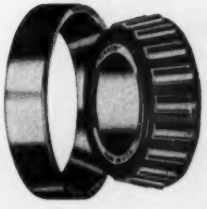

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tical design that has pipe-tap suction and discharge nozzles. Built in one barrel size it can have either an open or closed impeller bowl assembly. By omitting the barrel the pump can be used for sump or tank service. The barrel is 6-in. standard pipe flanged at the top to connect to the nozzle head. A flange at top takes solid-shaft 3550-rpm 1½-to-10-hp motors. Top ratings are 100 gpm, 350 psi, 250 F.

Byron Jackson Co, PO Box 2017, Terminal Annex, Los Angeles 54, Calif.

For more data on these items, use post cards, p171. Identify request with P and number.

QUICK-FREEZE UNIT P618

No Frost units are designed for refrigerating cold-test rooms, cold-processing like quick freezing of foods, and for food-products chilling and cold storage. Spray cooler supplies subzero-temperature-controlled cold-air stream by passing air over refrigerated coils. Constant spray of *No Frost* liquid prevents ice or frost on coils. Nonfreeze liquid is kept concentrated by continuously removing moisture from it. Unit holds temperatures to as low as —30 F without interruption for defrosting. Concentrators for unit have wide range of sizes with water-evaporating capacities from ½ to 75 gph. Single, large concentrator can serve a battery of several large spray coolers.

Niagara Blower Co, 405 Lexington Ave, New York 17, N.Y.

PIPE COATING P611

Asbestos-fiber coating, the gilsonite asphalt base, has been developed expressly for use wherever corrosion from soil acids or air-suspended acids attack metal structures for pipelines. It is made up as *Pro-Tek-To* pipe coating and requires no heating, special mixing, or preparation for application. It is said to be impervious to severe temperature changes, while retaining its mastic properties through a long service life.

Warren Refining & Chemical Co, 750 Prospect Ave, Cleveland 15, Ohio.

SOLDERING GUN P610

Lightweight, balanced, soldering-gun features (1) a nontiring pistol grip (2) extra-long-reach extension (3) dual heat permitting choice of either 100 or 150 watts (4) built-in full-view light. Various tips may be used, and no tools are required to change them. This model, Cal-88, has a single-pole design, which allows deep penetration without danger of unsoldering other parts in close work.

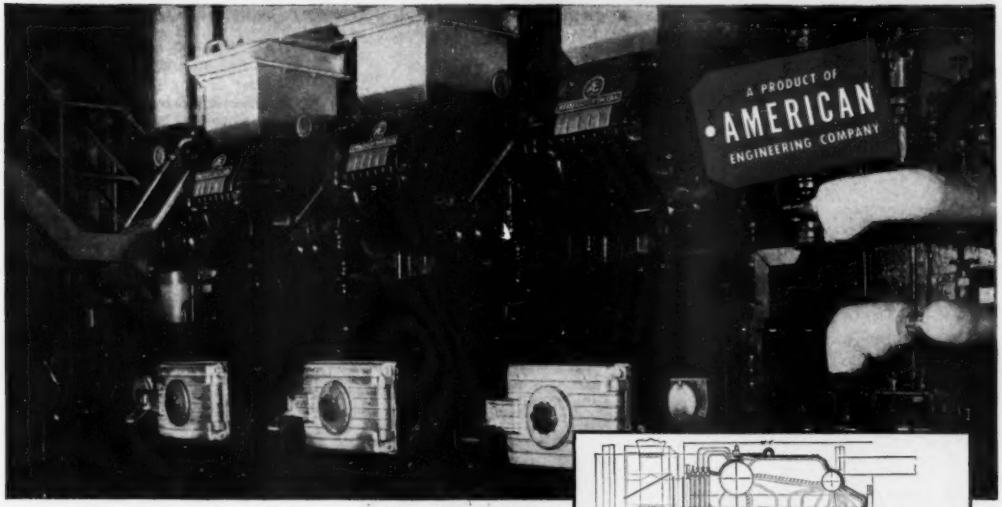
Cal-Iri Mfg Co, Inc, 15 Union St, Lawrence, Mass.

AIR CLEANER P609

Complete air-cleaning package resembles a factory-fabricated section of air duct or plenum chamber, 96 in. long with a built-

Merck & Co. Inc., get 85% boiler efficiency with

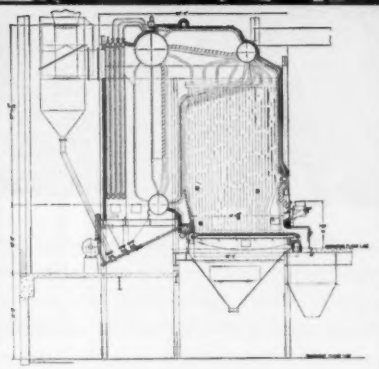
PERFECT SPREAD STOKER



TEST RUN of a recent Merck installation shows an actual boiler efficiency of 85% operating at average load of 71,500 lbs. per hour. The combination of a modern boiler and a Perfect Spread Stoker permits the use of economical high ash coals and assures big annual savings in fuel costs.

Perfect Spread Stoker burns high and low ash coals with equal facility. Its unique feeder provides positive, continuous coal feed and even distribution. *It never clogs on wet coal.* Its fly ash reinjection and adjustable overfire air system brings maximum fuel economy. And Perfect Spread has a capacity range from 8,000 to 500,000 lbs. of steam per hour. With individual capacities from 50 lbs. to 7500 lbs. of coal per hour, the chain conveyor feeder eliminates puffs of smoke common to slug stoking.

Send for booklet fully describing the Perfect Spread Stoker. And if you are considering boilers in capacities from 300,000 to 500,000 lbs. of steam per hour, call us in to discuss cross-firing.



Edge Moor 3-drum boiler fired by 3-feeder Perfect Spread Stoker with traveling grate. Design engineers, Smith, Hinchman & Grylls, Inc.

WON'T CLOG ON WET COAL

AE

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2400 Aramingo Avenue, Philadelphia 25, Pa.

Gentlemen: Kindly send me free copy of Perfect Spread Stoker booklet ( ). I should like to discuss cross-firing ( ).

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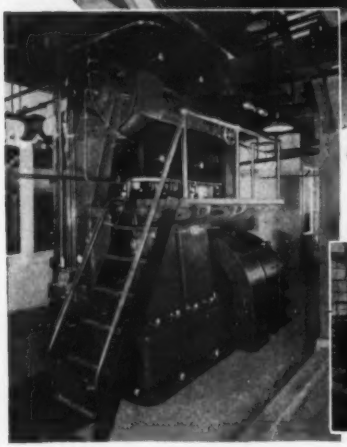
"UNIVERSAL UNAFLOW"
STEAM ENGINES



Two-Cylinder Skinner Vertical "Universal Unaflow" Steam Engine, directly connected to 400-kw., D. C. generator.

Skinner Horizontal "Universal Unaflow" Engine, driving 750-kv.a., generator.

Textiles of today come from the cotton fields, the flax fields, the sheep ranches, the forests, the coal mines, and the silkworms of the mulberry groves. Though the yarn they use comes from many different sources and is produced by various methods, the manufacturers of fabrics have three needs in common . . . they must have abundant, dependable power; they must have steam for processing; and they must have provision for space heating.

A SKINNER "Universal Unaflow" Engine installation provides all three . . . power from man's most economical steam prime mover . . . exhaust steam for processing . . . exhaust steam for heat.

SKINNER "Universal Unaflow" Steam Engines enjoy an enviable record of service in the textile industries that extends back over four decades and continues to grow year by year.

Write for case studies of what has been accomplished in industries similar to yours.

For Over 80 Years Doing One Thing Well — Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

More EQUIPMENT NEWS

Begins on page 162

in Precipitron. Known as Type PE, packages are available in air-cleaning capacities ranging from 8330 cfm at 90% efficiency to 44,000 cfm at 85%. These efficiencies are measures by U. S. Bureau of Standards blackness test method.

Over-all cross-sectional dimensions range from 5 ft, 4 11/16 in. high 5 ft, 2½ in. wide, for the 8330 cfm unit to 10 ft, 4 11/16 in. high x 11 ft, 1¾ in. wide for the 44,000-cfm unit. All are 8 ft long. Approximate weight is from 1970 lb for the smallest unit to 8000 for the largest.

Westinghouse Electric Corp, 200 Readville St, Hyde Park, Boston 36, Mass.

For more data on these items, use post cards, p171. Identify request with P and number.

ONE-PIECE SEALING RING P626

This one-piece sealing ring has the sealing member on the inner side of the ring. *Inseal* has no "top" or "bottom," seals fully from both sides and cannot be installed upside down. It is suitable for single-groove double-acting pistons in engines, compressors and pumps. A semi-locking arrangement adapts it for use in all two-cycle engines. Ring is said to increase efficiency, lower fuel consumption, have longer life, eliminate damage caused by burning gases escaping through ring gap, and increase cylinder-wall life. Available in sizes of 4 to 96 in. dia.

Double Seal Ring Co, Fort Worth, Texas.

ROOF COOLER P603

Small vane-equipped waterwheel receives water from a special nozzle fitting aimed to spray a jet of water on the tip of the moving blades. These blades then throw a spray of water over the roof surface to remove the heat load from direct solar radiation. A ⅜- or ½-in. pipe from the nearest water line to the rotary roof cooler is all that is needed to supply water. The spinning wheel rotates the cooler on its support through enclosed gears, causing the spray to cover the entire roof surface gradually.

Result is a thin film of water permanently renewed on the roof. As the water film evaporates the spray replaces it.

Siegfried Ruppright, Box 6795, Los Angeles 22, Calif.

DIAPHRAGM HAND PUMPS P627

Designed for safe operation, these pumps are approved by Underwriter's Laboratories for dispensing gasoline, and other petroleum-base products, glycerin, alcohol, turpentine and other solvents. They have bung adapters with vise-type screw, which can be tightened on the suction stub without a wrench or pliers. Suction stubs are galvanized, and all metal parts not made of stainless steel are treated on the inside to prevent rust and corrosion. These pumps

NOW . . . Coppus-Dennis FANMIX Action REVOLUTIONIZES OIL BURNER PERFORMANCE 6 WAYS!

1. **INCREASES BOILER RATINGS** because all of your furnace space is used for combustion . . . none for mixing.

2. **STEPS UP FUEL EFFICIENCY** because complete combustion is guaranteed with 5% to 10% excess air.

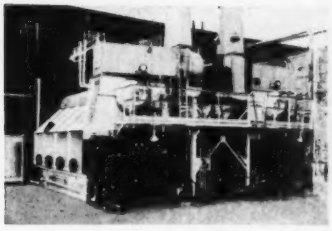
3. **GETS RID OF "HOT SPOTS"** because continuous explosion kills torch action and disperses heat uniformly.

4. **ELIMINATES FORCED DRAFT EQUIPMENT** because FANMIX action itself overcomes the entire draft loss across the burners.

5. **CUTS STACK REQUIREMENTS** because the forced draft created by FANMIX action calls for less furnace draft.

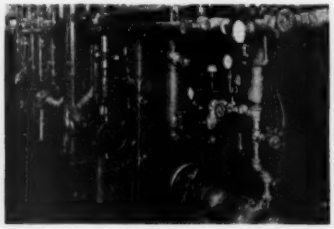
6. **REDUCES COKING OF ATOMIZERS** because their tips are air-cooled by the fan blades to a point well below the coking temperature.

COPPUS-DENNIS FANMIX OIL BURNERS, thoroughly proved in important installations for more than two years, utilize jet reaction of steam-atomized oil to rotate a fan which is an integral part of the burner. Automatically adjusted proportion of high velocity air passes at right angles through the sheet of atomized oil to create an ideal mixture for fast, complete combustion — peak efficiency.



COMMERCIAL SOLVENTS CORP. plant, Terre Haute, Indiana, utilizes Coppus-Dennis FANMIX Oil Burners to fire two fully automatic 250 hp steam generators. Installed early in 1948, these two units have since been supplemented by a third.

AMERICAN WOOLEN CO., in one of its plants, has equipped two 1000 hp boilers with six Coppus-Dennis FANMIX Oil Burners.



BROCKTON EDISON CO. relies on four Coppus-Dennis FANMIX Oil Burners in its plant in East Bridgewater, Mass.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

INVESTIGATE! If you share in the responsibility for the efficiency of your firm's boiler operations, it will pay you to learn why Coppus-Dennis FANMIX Oil Burners, made to Coppus Blue Ribbon standards of quality, promise such superior performance. Send the coupon today.

Please attach this coupon to your company letterhead

COPPUS ENGINEERING CORPORATION
166 Park Avenue
Worcester 2, Mass.

Please send complete data on Coppus-Dennis FANMIX Oil Burners.

Name..... Title.....

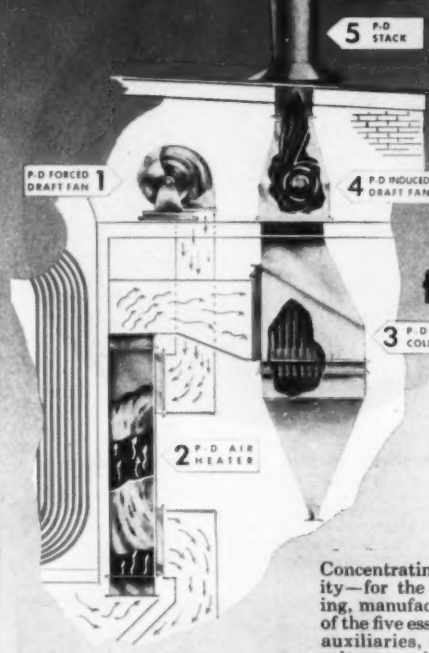
Company.....

Address.....

City..... Zone..... State.....

UNIT RESPONSIBILITY

. . . from one source pd



the 5 essentials for handling the air-gas stream

Concentrating the responsibility—for the design, engineering, manufacture and delivery of the five essential boiler plant auxiliaries, relieves the consultant engineer and general contractor of this problem.

The Thermix Corporation, project engineers for Prat-Daniel equipment are glad to offer you their wide background in the proper application of (1) P-D Forced Draft Fans; (2) P-D Air Heaters; (3) P-D Tubular Dust Collectors (standard Valmont and Decantation); (4) P-D Induced Draft Fans; (5) P-D Fan Stacks.

Your over-all plan is simplified when the complete responsibility for the production and control of gas is placed with P-D, a firm known to the Utility and Power fields for over a quarter of a century. This unit responsibility means less details for you.

Why not let Thermix show you how you can save time and effort by specifying P-D equipment. Write today for the latest catalogs.

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More EQUIPMENT NEWS

Begins on page 162

can be installed in 1½- and 2-in. bungs of drums or tanks. Operating with a single diaphragm, they pump on both forward and backward strokes and have a capacity of 1 gal per 5 strokes.

Tokheim Oil Tank & Pump Co, Fort Wayne, Ind.

For more data on these items, use post cards, p171. Identify request with P and number.

FAN CONTROL P617

Control of fan output from 15 to 100% full load is said to be possible with a heavy-steel vane control available in four models: Model 6 for light-duty fans, 7 for dusty gas, 8A for industrial applications where gases are free from solids, and 8B for industrial and ventilating service where shaft bearings are supported on fan casings. No change in speed of either fan or motor is necessary because vane control changes fins of entering air to modify fan pressure.

Westinghouse Electric Corp, Sturtevant Div, 200 Readville St, Hyde Park, Boston 36, Mass.

REFRACTORY INSULATION P601

Permanent, lightweight, nonshrinking insulation, *Hylag*, is a multi-use refractory insulation. It is reported not to dissolve, collapse, or powder off on contact with steam or water. It is said to withstand shock, vibration and abrasion and not be damaged by crushing. *Hylag* may be easily troweled or sprayed on brick, metal lath, or concrete block. The K factor is low. Only precaution is that the material must not be pressed on because it bloats within three-quarters of an hour after application and becomes honeycombed with air cells.

Continental Coating Corp, 304 E 44th St., New York 19, N. Y.

LOW-PRESSURE CHECK VALVES P621

Slightest whiff of pressure opens these check valves designed for very low-pressure pneumatic or gas systems. Available in brass or aluminum; other materials used if ordered. Cracking pressure is 4- to 8-in. water. Valve seals before pressure across poppet is equalized and holds bubble tight against any backpressure within its rated range of 0-100 psi. Sealing is obtained with a poppet, which has an accurately machined knife edge impressed into the surface of an "O" ring. Designated as the 119 series.

James-Pond-Clark, Pasadena, Calif.

VARIABLE-SPEED PULLEY P631

To be mounted on the shafts of motors up to 15 hp, these pulleys give a 3-to-1 speed range.

Gerbing Manufacturing Corp, 11801 Milwaukee Ave, Northbrook, Ill.

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Controlled Quality

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...to be sure of sound welds and fast assembly

TO MARK PROGRESS

Keeping welding costs down to a minimum and erection schedules on time... these are important advantages you can assure to any piping job by installing Ladish Controlled Quality fittings. Metallurgical controls over materials and methods provide an assurance of uniform weldability in every Ladish fitting... and thorough inspection to rigid standards of physical dimensions and geometric accuracy assures fast piping assembly.

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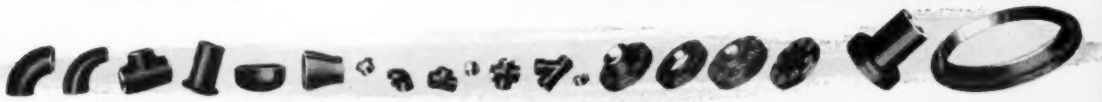

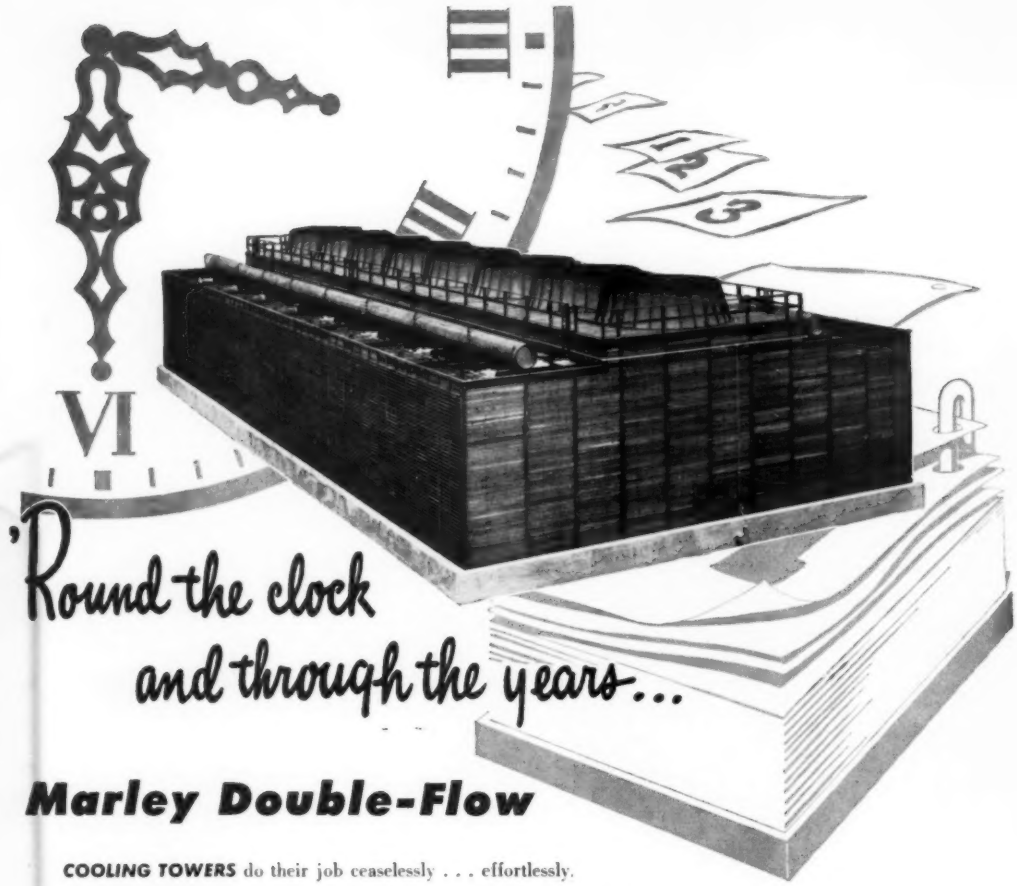

'Round the clock
and through the years...

Marley Double-Flow

COOLING TOWERS do their job ceaselessly . . . effortlessly. Designed for long-service life, Double-Flow dependability is further assured by the patented design that makes possible "at-a-glance" inspection, on-the-spot maintenance—all without service shutdowns or lag in plant production.

The famous Marley open distribution system keeps the operator informed at all times on water conditions, and may be cleaned in minutes, during operation. By merely opening a door, the operator can walk through the entire tower, inspecting all essential parts as the Double-Flow continues to do its duty.

Marley fans, Geareducers, drive shafts—all designed for cooling tower service exclusively—are keyed to this same service simplicity. Mechanical equipment . . . distribution . . . filling . . . basin . . . from top to bottom and side to side, Double-Flow towers and *only* Double-Flow towers are an open book to the tower operator—a book that tells a story of ceaseless, effortless operation.

The Marley Company, Inc.
KANSAS CITY 15, KANSAS

MARLEY

Does all this add up to specialized and specific know-how?

. . . discounting past performance and metallurgical research, we have in work, at the present moment, orders for critical or complete utility power piping for units with operating conditions up to 2300 psi and 1100F . . . 19 units for service at 1000F or above . . . pressures of 1400 psi or higher . . . 17 units of the REHEAT type . . . totaling to more than 2-1/2 million new kilowatts of capacity.

Does all this add up to specialized and specific know-how of value to you?

NEWS FOR OPERATORS IN WESTERN CANADA!
Canadian Kellogg Company has established complete shop facilities for the fabrication of all types of piping at **EDMONTON** in Alberta Province. Inquire directly or through any Kellogg office.

To matter, temperature, pressure and chemicals we add

M. W. KELLOGG

piping and process equipment

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

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50th ANNIVERSARY
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Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

- Pressure Vessels
- Vacuum Vessels
- Fractionating Columns
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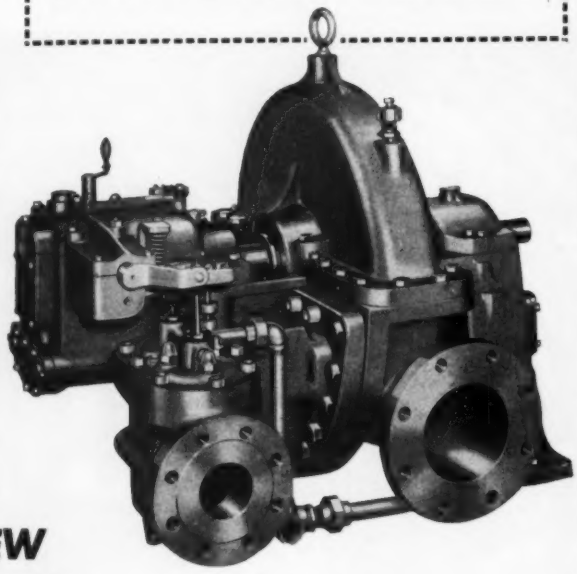
NEW! MURRAY

TYPE H

MECHANICAL DRIVE SINGLE STAGE STEAM TURBINE



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FEATURES

- Enclosed 'shaft-through' governor
- Fast acting hand speed changer
- Improved spark proof emergency stop
- New convenient hand valve position
- Easily removed governor valve and seat
- Removable perforated metal steam strainer
- Large bearing oil reservoirs
- Large finned-tube oil coolers
- Magnetic oil-drain plugs
- New type split oil rings
- Corrosion resistant carbon packing cases
- Chrome plated shaft under carbon rings

Combining a host of new improvements plus time tested features, the Murray Type H offers extra-value in a medium size machine. With a range of 50-200 H.P., depending upon speed and steam conditions, it is offered with either a 16 or 20" diameter wheel. 3" or 4" steam inlet sizes available. Steam conditions up to 600#, 750° and back pressures up to 150# can be used.

Write today for full details.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

More TECHNICAL BRIEFS

Begins on page 158

heat losses. It should carry an indicating gage to show oil level and a means of pole-gaging the tank for check purposes. In addition, there should be a ladder or stairway at the tank's top. The tank should carry a vent to atmosphere so located as to prevent rainfall from getting into it. Storage tanks should also be equipped with man-heads near the bottom for easy manual cleaning, if necessary. There should be a top overflow connection to the sewer or some suitable safe container or pit to prevent (1) filling the tank overflow to the top man-head or vent and (2) letting it run down the outside of the tank. A water draw-off or drain on each storage tank is a must. *Mich. combustion conference paper. No number.*

SPREADER STOKERS FOR LARGE BOILERS, *by J S Bennett, American Engineering Co.* Large-capacity boilers really got their start at the Delray plant of Detroit Edison Co in 1910 when double-ended multiple-retort stokers and double-ended bent-tube boilers were installed.

Except for small boilers, spreader stokers were not taken seriously until recent years. In the late 1930s, improved application engineering and a development of continuous discharge of ash broadened this stoker field. Single units up to a half million lb per boiler per hr capacity are being discussed. *MWP paper. No number.*

Directions for ordering papers on p 160

GAS ANALYZER FOR BETTER COMBUSTION, *by C H Barnard, Bailey Meter Co.* Automatic gas analyzer and gas-analysis control have been applied to various combustion processes. Their application is the subject of this paper. Combustion in both oxidizing and reducing atmospheres is covered. For the oxidizing atmosphere, a catalytic combustion-type oxygen analyzer serves. It uses a standard fuel to burn out excess oxygen on a catalyst filament. For reducing atmospheres a similar analyzer uses air for fuel to burn unburned combustible gas. *Mich. combustion conference paper. No number.*

BURNER TESTING OF FUEL OILS, *by D R Walsh, Gulf Research & Development Co.* Fuel quality may be determined by an index developed from three factors, namely, smoke density, soot thickness and stack rise. A full-term burner test provides an indication of how high smoke density can go before a boiler fails in a year's operation from deposit accumulations either by throwing the burner off CO_2 setting, or by raising

"Tycol Aturbrio resists heat and sludging... turbines operate for years without shutdown"

Correct! Tycol Aturbrio Oils resist emulsification, foaming and deterioration even when turbines operate continuously. Oiling systems stay clean longer—uninterrupted service is assured. Tycol Aturbrio Oils are "double inhibited" to give utmost rust and oxidation resistance. They keep costs down... hold wear to a minimum.

For further information, get in touch with your nearby Tide Water Associated office. Write or wire today.

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SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"

This
TRIPLE ACTING
NON-RETURN
VALVE

Automatically

✓ **Opens** when boiler pressure equals header pressure

✓ **Isolates** and prevents back steam flow into a defective or lower steaming boiler

✓ **Prevents** boiler steam flow when steam line or header is ruptured.

GOLDEN-ANDERSON

also makes this Single-Acting Non-Return Valve

which will automatically open to cut-in the boiler when its pressure equals the header pressure and automatically close to isolate the boiler when its pressure decreases.

Bulletins S-1A and S-2 contain complete technical data.

GOLDEN ANDERSON Valve Specialty Company

2070 KEENAN BUILDING • PITTSBURGH 22, PA.

More TECHNICAL BRIEFS

Begins on page 158

draft resistance enough to produce pressure in the combustion chamber. *Mich. combustion conference paper. No number.*

Boiler Auxiliaries

INSTRUMENTATION AND CONTROL FOR SMALL POWER PLANTS, *by P S Dickey, Bailey Meter Co.* Basic objectives of instrumentation and control are (1) improved fuel economy (2) minimum overall cost (3) safe and reliable operation (4) efficient utilization of personnel.

Since it is difficult to define a small power plant, the author selects four general types representing different industry problems and discusses the application of instruments and controls to each plant type. They are (1) small coal-fired boilers (2) small oil- or gas-fired boilers (3) medium-sized boilers in industrial plants (4) control stations, power plants. A check list is worked up for the medium-sized plants, that is 30,000 to 200,000 lb per hr and up. This check list covers the types of controls suggested, the reason they are included, as well as the same coverage for recorders and their function, plus suggested indicators. *MWP paper. No number.*

RETRACTABLE SOOT BLOWERS IN CENTRAL STATION BOILERS—*Comparison of Air and Steam Blowing, by D E Hibbner, Vulcan Soot Blower Div, Continental Foundry & Machine Co.* The author begins by describing the retractable soot blowers, their construction and function. In large-sized boiler installations it is always advisable to provide servicing platforms either above or below the soot-blower unit. Several companies estimate it takes from $500 to $1000 just to take a unit off the boiler and put it back again, not including work done while the soot-blower unit is in the shop.

Advantages cited for the retractable over the fixed rotary soot blower are: (1) greatly increased range (2) reduced number of units needed to service an area (3) ease of location (4) lower maintenance (5) complete availability of the boiler as far as soot blowers are concerned (6) greatly lessened danger of tube cutting (7) considerably smaller amount of required critical material (8) an ability to put soot blowers into sequential and remotely operated systems at little extra cost.

The paper closes with a comparison between steam and compressed air as blowing mediums, listing advantages and disadvantages of each. *MWP paper. No number.*

Directions for ordering papers on p 160

You've heard of FLUOR QUALITY ...here's proof

You've only to look into a Fluor Counterflo Cooling Tower for the proof of quality—quality of design, of manufacture, of performance, and of appearance. The points illustrated below are just a few of the many features that have earned Fluor Towers their enviable reputation for quality—compare them when next you buy or specify.

GRID DECKS

Rugged checker-bar grid decks are of rough-finished 1" thick select redwood—with unrestricted supported spacing and cleaning and are sufficiently strong to support a man's weight on the planes of screening and replacing. Prefabrication and structural strength permit use of grid decks as scaffolding during erection.

DRIFT ELIMINATORS

Fluor Drift Eliminators are designed for minimum resistance to air flow induced through the tower. Two-pass, zig-zag pattern removes entrained water droplets from the air stream and contains drift loss to less than 0.2 of 1 per cent of water circulated.

STACK and FAN ASSEMBLY

8' high fan stack of 2" thick tongue-and-grooved redwood staves, rigidly ringed with steel angles and straps. Fan stack is supported on heavy ball-mounted metal rings—Drive shaft, corrosion resistant, right-angle reduction gears and stainless steel fan blades assure long life and low maintenance—Patented Vibration Cut-Out Switch guarantees safety.

DISTRIBUTING SYSTEM

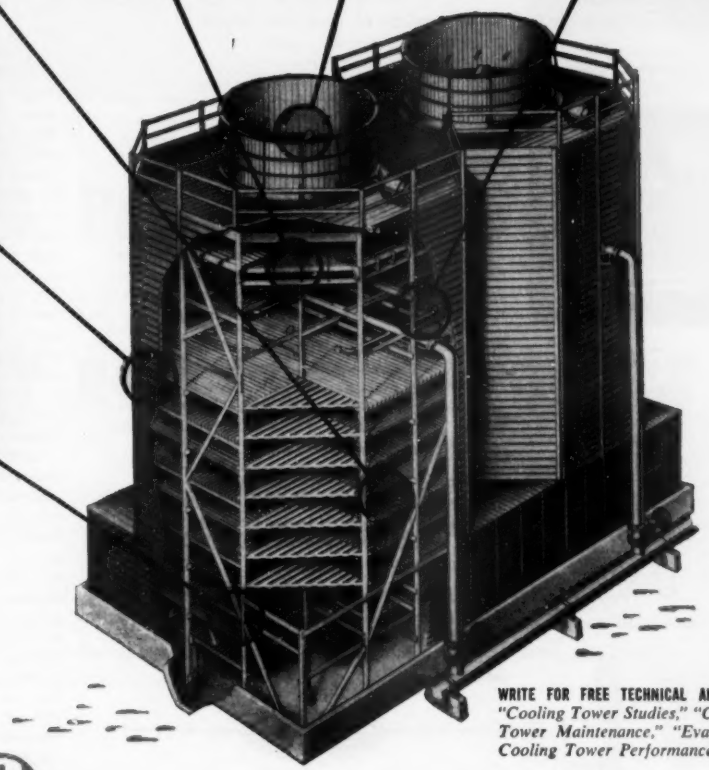
Complete pressure system on each precious portion of heat load on water covers the tower. Patented non-clogging, self-draining Spray Frame nozzles insure water breakup under maximum pressure. Nozzle spacing controls uniform water distribution. Cell distributing systems are independent to assure maximum control over any or water being cooled.

DOUBLE-WALL SHEATHING

Panels of sheathing are pre-assembled in uniform sizes to enable fast, easy installation. Inner wall is of 1" tongue-and-groove redwood—outer wall is of 5/8" battens spaced 1-1/16" apart—2" spacing between walls permits air circulation and prevents dry rot.

TOWER STRUCTURE

Rugged 4" x 4" posts with 4" x 4" and 3" x 4" bracing—Corrosion-proof bolted internal gusset plate structure—joints take both tension and compression for extra safety under all conditions. Posts are on 6' centers. Columns and bracing are designed with foresight to future tower extensions—panels are reusable on new extension—bracing and columns need no modification.



WRITE FOR FREE TECHNICAL ARTICLES: *"Cooling Tower Studies," "Cooling Tower Maintenance," "Evaluating Cooling Tower Performance."*

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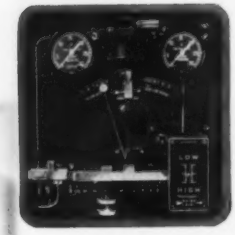
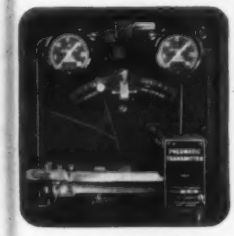
ONLY MASONEILAN

12,000 Series Liquid Level Controllers

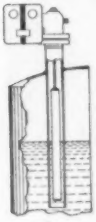
Give You All These Advantages



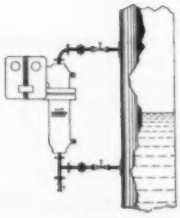
Model 12600
Proportional Control



Model 12620
Pneumatic Transmitter



Top Vessel Mounting



Top and Bottom
Screwed Connections

Nowhere except in the Masoneilan 12,000 Series Variable Displacement Level Controllers will you find such a wide choice of essential characteristics.

Wide Variety of Controller Types

Proportional controller, proportional plus reset controller, pneumatic transmitter, two-position differential gap controller, three-position pneumatic signal switch; duplex types — proportional controller and pneumatic transmitter, proportional-reset controller and pneumatic transmitter, proportional controller and pneumatic signal switch (and other combinations as required).

Selection of Mountings

Two internal mountings—top or side vessel flanged connection; eight external mountings — displacer chamber with screwed or flanged connections arranged for best adaptability to a variety of vessels. Right or left hand instrument case mounting.

Selection of Torque Tube Materials

Selection of torque tube assembly material best suited for the application. Standard is Inconel. Monel, Type 316 Stainless Steel, or Phosphor Bronze also available. (Materials offered subject to availability during shortages.)

Available in Many Ranges

12,000 Series Level Controllers are available in many standard ranges — 14 and 32 in.; 4, 5, 6, 7, 8, 10 and 15 ft. Other ranges can be supplied for special applications.

Meet Great Variety of Applications

Typical applications include level in fractionating or crude towers, accumulators, separators, sumps, chillers, feed water heaters, settling tanks — many other applications.

MASONEILAN

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Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

ELECTRONICS

Continued from page 100

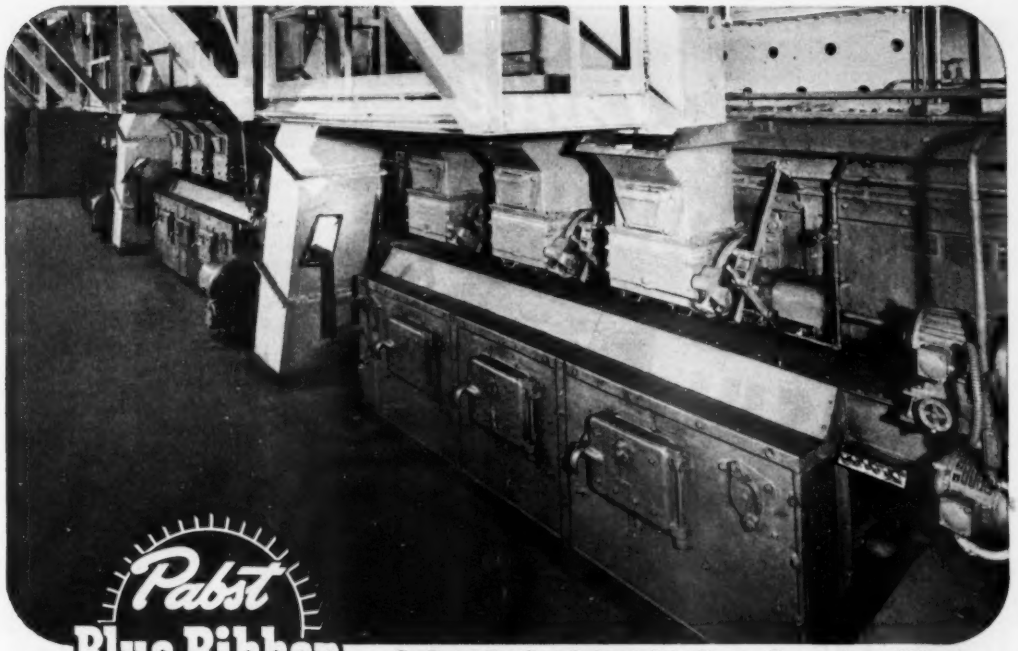
If arm A is moved counterclockwise to L_1, all resistance of potentiometer P is now in T_1 and T_2 grid circuits. The potentiometer is in parallel with the shunt-field coils, so full voltage drop across these coils is also across P. This voltage may be higher than that across the armature, so the *dc* grid voltage, which is armature minus that across P and R_{10}, is less than that from cathodes to the anodes of T_1 and T_2. The grids are thus given a plus bias with respect to the cathodes.

This bias is applied on T_3 from cathode to grids through R_{13}, R_{14}, R_{10} and R_{12} to L_1, through tube T_4 to V or W on the power transformer. The grids are driven sufficiently plus to raise the ac rider so it fires tubes T_1 and T_2 at the beginning of the anode voltage wave. Rated voltage is now applied to the armature and it comes to base speed. Then by moving arm A of potentiometer P from L to L_1 motor speed can be adjusted from a low to rated value.

IR-Drop Compensation. The IR-drop compensation resistor R_{10} serves to hold motor speed constant with load changes. Windings P_3 in series with T_1 and T_2 anodes are primaries for current transformer secondary S_3. Current through P_3 windings, even though it is always in one direction, is not a smooth dc but is pulsating in waves. These windings are so connected in the current transformer that the current wave in one is in one direction, while the current in the other primary is in the opposite direction. This gives the effect of a single-phase ac in the transformer, which induces a voltage in secondary S_3 proportional to the current flow through T_1 and T_2, the motor armature current.

Current flows from tap X_1 on S_3 through R_{10}, and either R_7, R_8 or R_9, depending on size of motor, back to tube T_3. In the diagram the selector switch is set for a ½-hp motor. This current causes a voltage drop across R_{10} that opposes the grid potential. Assume the motor is operating at a given speed and load, when the load increases. For more current to flow through the motor it must slow down to reduce the armature's counter-emf. But the increased load current flows through P_3 to increase voltage of S_3. Current flow through R_{10} and R_7 increases as does volts' drop across R_{10}. This increased volts' drop makes the grids less minus to reduce voltage drop across the tubes and increase it across the armature to hold the speed at nearly set value.

Current-Limit Control. During starting and overloads, armature current



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ELECTRONICS

Continued from page 196

is limited to a safe value by the current-limit circuit, part of which is the *IR*-drop compensation just described. Control tube T_4 and current transformer P_3S_3 act with capacitor C_4 to produce a voltage between leads *D* and *E* proportional to armature current. This current is of three different values depending on the setting of the selector switch.

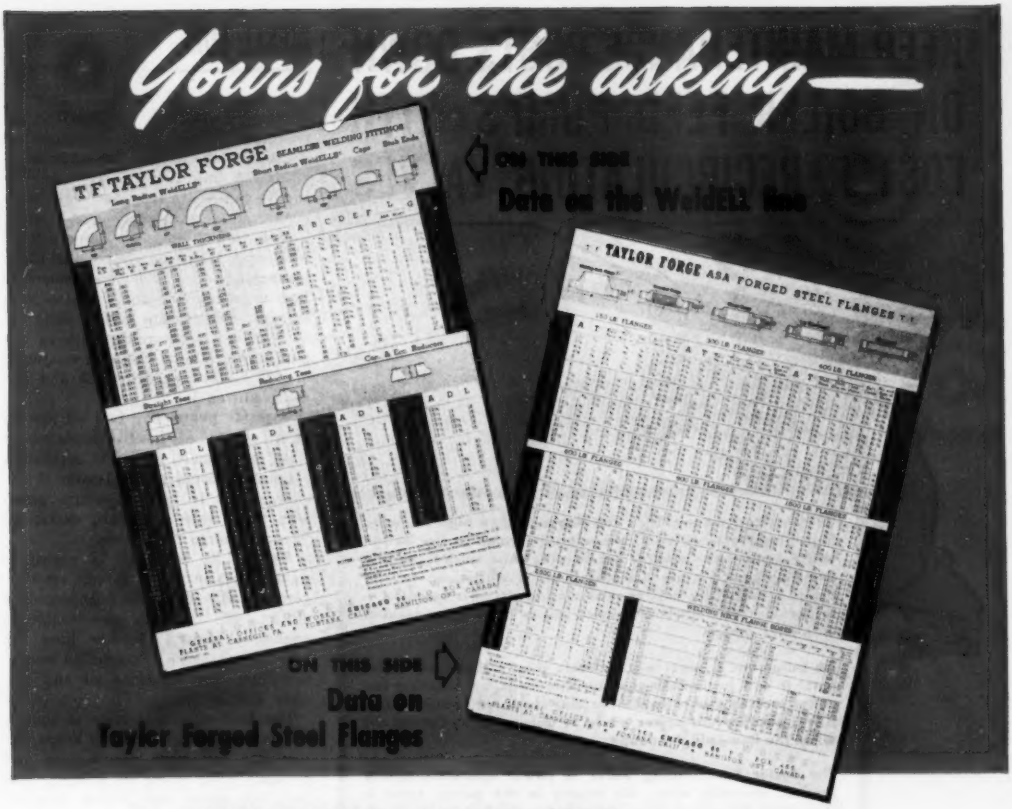
If a sudden overload produces a current rush through the tubes and current transformer P_3S_3 that causes a voltage difference of 200 v from *D* to *E*, voltage-regulating tube T_4 conducts. This tube will hold the voltage across it at 150 v, so there remains 200–150 = 50 v as a minus bias on the grids of tubes T_1 and T_2. This bias is applied from the grids to cathodes of T_1 and T_2, through T_4 back to T_3, and limits the maximum current that can flow through the motor's armature and tubes T_1 and T_2 to a safe value.

Capacitors C_3 and C_4 stabilize control operations to prevent two quick changes in motor current that might cause hunting. When arm *A* is on *L* of potentiometer *P*, voltage on the right-hand side of capacitor C_2 is higher than on the left, and the capacitor is changed to the voltage difference to the polarity shown. Quickly moving arm *A* to the position shown would cause a sudden drop in dc minus bias on T_1 and T_2 grids and an equally sudden increase in voltage across the armature and speed increase if it were not for capacitor C_2. When the grid potential drops C_2 tends to discharge from the grids to cathodes of T_1 and T_2 to prevent a sudden shift in the grid ac rider voltage. As voltage of the capacitor gradually decreases to that corresponding to the new position of arm *A*, the motor comes up to speed without overshooting.

Capacitor C_4 serves a similar purpose in the current-limit circuit. Assume that a heavy overload comes on the motor. This will cause a rise in voltage across capacitor C_3 and it will be charged to this voltage and the polarity shown. As previously explained, voltage-regulating tube ionizes and the grids of T_1 and T_2 are driven minus to limit current flow through the motor.

When the overload passes, C_4 is charged to a higher voltage than normal. It then tends to discharge from grids to cathodes of the tube to prevent too sudden a change in grid bias and maybe hunting of the motor. As capacitor C_4 discharges through R_{13} and R_{12}, conditions gradually return to those that existed before the overload.

Yours for the asking—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Here is just about the handiest tool ever devised for the pipe designer. Data on welding fittings and flanges that otherwise could be found only by plowing through many catalog pages and tables have been ingeniously condensed on the two sides of the durable letter-size card illustrated above.

One side covers the broad WeldELL line of Taylor Forge welding fittings. For every nominal pipe size, ½" through 30", it shows the wall thickness for every weight of every fitting in every available material. It also shows all required dimensions of all types of fittings.

The other side covers the world's most complete line of forged steel flanges. For every nominal pipe size, ½" through 24", it gives all essential dimensional and bolting data for all types of flanges in all weights. A particularly useful table (see reproduction) is that showing welding neck flange bores which enables you to determine the I.D. of any nominal pipe size without separate calculation. Thus the sheet gives you O.D. and I.D. of any weight of pipe.

The card is varnished to make it stand the steady usage you are certain to give it. To obtain your copy see your Taylor Forge distributor or **MAIL THE COUPON.**

TF

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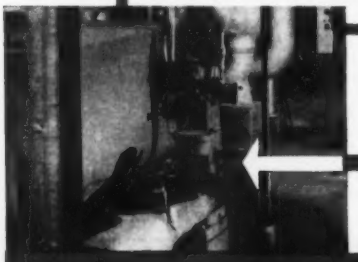
KEEP MAINTENANCE COSTS DOWN ON BOILER FEED PUMPS WITH FOSTER RECIRCULATING VALVES

Burnouts cost money. They can happen when high capacity, high pressure centrifugal pumps are operated at *low output* without protection against overheating. And since there is a *low flow* period every time the pump is started up or shut down, a proper by-pass or recirculating circuit is essential — to provide sufficient flow to carry away the heat generated within the pump.

An automatic by-pass will do more than just prevent burnouts. It will further cut maintenance costs by reducing impeller erosion due to cavitation and excessive entrained air. It will also prevent power waste by automatically cutting out when the flow is high enough.

The Foster Recirculating Valve is power operated, spring loaded, normally open. Air supply to the power head is through a three-way solenoid valve controlled by a switch operated by the pressure drop across a metering element in the discharge line. When the discharge flow is below a satisfactory minimum, the valve stays open, permitting recirculation. It guaranties that the pump will never run dry (have zero flow while running). When, however, the discharge flow is satisfactory, the valve closes, preventing power waste.

The Foster Recirculating Valve can be used in conjunction with any suitable controlling device.



Typical Foster Recirculating Valve installation in a large Eastern Utility. Since the first six were installed in 1937, eighteen more have been installed as standard equipment to protect boiler feed pumps.

FOSTER ENGINEERING

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DIESEL FUEL

Continued from page 96

Where means are not provided for continuous logging of fuel consumption, occasional checks can be made more easily by installing 3-way cocks in supply and return lines near engine for connecting to temporary test tanks.

Drip Tanks. Many engines are fitted with drip tanks to collect fuel-pump leakage, etc. For close measurement of fuel consumption, credit engine with amount of drips. This may be done by: (1) physically returning drips to day tank to which input has been measured, or (2) calibrating drip tank and giving credit on log.

Transfer pumps for fuel oil are almost always of positive-displacement type, using gears, screws or oscillating pistons. To avoid pump damage if discharge line is blocked, equip pump with relief valve to return excess oil from discharge to suction.

Piping. Be sure all oil piping is tight. Leaks in pressure lines are dangerous. Leaks in suction lines introduce air into oil; this may give trouble in engine. Drip and overflow lines are seldom full, hence if connected to suction lines may introduce air and possibly kill suction.

Use foot valve at bottom of suction line in oil-storage tank. This keeps suction line full when pump stops and prevents pump losing its priming. Protect foot valve with coarse strainer. Some strainer-valve combinations are designed so oil comes through strainer above valve suction opening. This permits putting strainer at desired point above tank bottom yet gives full drawdown to that point. Provide ready access to foot valve and strainer for cleaning.

Safety Devices. Local ordinances or insurance regulations often require means for stopping engines (in case of fire, etc) from a point outside engine room. This is often done by installing a quick-closing lever-operated gate valve in fuel-supply line near engine and running a chain from valve to a hook outside engine room.

Suction lines from storage tanks are often carried to points in engine room *below* oil level in tank. If pipe should be broken at such a low point, contents of tank may flood engine room by siphon action or by direct gravity flow. To prevent such flooding, safety inspectors sometimes require installing an anti-siphon valve. These valves close if suction on engine side is broken, hence are effective only when there is a transfer pump at the engine. Where there is not, some form of valve controlled by flow rate and designed to close when flow exceeds a set limit may be used.

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AXIAL COMPRESSORS

Continued from page 91

the slide wire increases with rising inlet-air temperature and decreases with a falling one. This enables continuous measuring of true temperature ratio with high accuracy.

Ratio instruments are in the gallery overlooking the compressors in the test way. Fig. 2 shows the temperature ratio recorder on a panel along with other instruments and the dual controls governing compressor operation from this point. A potentiometer, indicating and recording pressure ratio, mounts on the same panel. This potentiometer works with special pressure transducers. These transduce absolute pressure into electrical energy. Transducers in inlet and discharge lines connect so the electrical energy varies with the absolute pressure ratio.

Ratio instruments eliminate considerable manual computation that had to be carried on continuously. They also avoid delays in obtaining information on immediate conditions with the possibility of wrecking the compressors. In addition they make it possible to estimate the current condition of the compressor in regard to cleanliness.

WEARING RINGS

Continued from page 103

be tight. This causes the wearing ring to bulge at the pin with soft materials, Fig. 6, or it may cause stellite or Colmonoy to crack.

We have found that the best method is to insert pins through the impeller wearing ring into the impeller, Fig. 8. This method permits drilling holes in the ring before hardening and not upset the metal after the pin is in place.

For rings overlaid with stellite or Colmonoy, we use much the same procedure except that the pin is inserted from inside the impeller's eye into the wearing ring base metal, Fig. 9. With either method, three 3/16- or 1/4-in. stainless-steel machine screws are used per wearing ring. After the screw is tightly bottomed, it is sawed off; then it is peened and dressed down with a fine file.

Locking of the casing wearing ring against rotation is much simpler. Stepped tongue and groove in Fig. 11, a key in Fig. 12, or screws in Fig. 10 are equally effective.

It is important that wearing-ring materials be selected that will not gall with reasonable clearance and at the same time meet specific requirements of corrosion and abrasion resistance.

AVOID DOUBLE TROUBLE

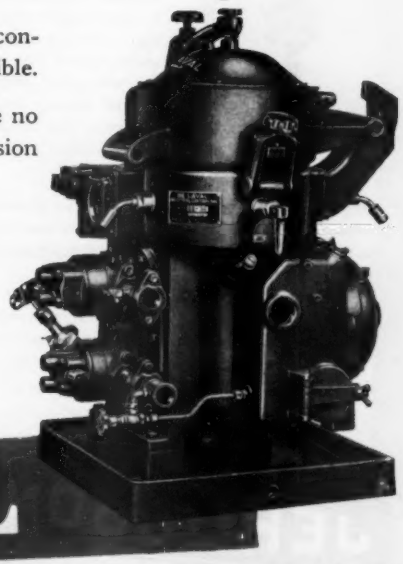
WITH A DE LAVAL

Dirt and water in your turbine lubrication system are double trouble-makers. Get rid of both of them with a De Laval Oil Purifier and give your turbine ***Double Protection.***

By means of centrifugal force applied effectively in the bowl, a De Laval machine throws out any solid impurities that may be present. Once removed, they cannot build up in the separating zone of the bowl to cause loss of purifying efficiency; they remain packed around the bowl periphery until cleaning time.

Any condensate in the oil is thrown out and continuously discharged. Re-contamination is impossible.

De Laval Purifiers cost little to operate—require no replacement of vital parts—and almost no supervision except cleaning.



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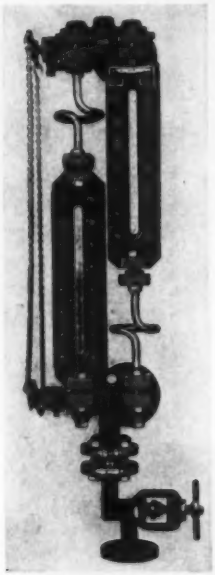
Rugged, Space-Saving Design, Expansion Coils, Other Special Features Insure Best High Temperature Performance



YOU'LL find that this Jerguson Model 618HP Gage will give you the kind of job you want in your power plant . . . rugged, efficient, uninterrupted, long life service.

You are assured of top performance because Jerguson has built the Model 618HP to meet the most exacting requirements of high temperature work. Both chamber and cover are rugged forged steel. At either end are specially designed Jerguson *expansion coils*. These coils, by absorbing excessive expansion and contraction, insure proper functioning of the gage under highest temperature conditions, and are another special Jerguson feature that assures you of highest accuracy and dependability. Valves on the Model 618 are for flanged or socket welding connections with outside screw and yoke.

Jerguson High Pressure Steam Gages are available in all pressures to suit your needs. The Model 618HP meets exacting Navy requirements and is now in use on scores of U. S. battleships and destroyers. It will pay you to investigate.

Jerguson offers a complete line of high pressure steam gages, inclined gages, and remote reading gages for power plant use. Write today, without obligation, for free illustrated DATA UNIT on the type of gage in which you are interested.

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SPRINKLER SYSTEMS

Continued from page 82

tageous. It operates with as much as 30-F less ceiling temperature, a distinct gain when measured in minutes and seconds.

For intermediate-degree sprinklers, solder-type opens at 212 F, non-solder at 175 F; hard-degree sprinklers operate at 286 F for solder and 250 F for non-solder; extra-hard degree sprinklers act at 360 F for solder and 325 F for non-solder. For exceptionally high normal-temperature areas, non-solder type sprinklers are obtainable with even higher trigger temperatures on special order.

Added to their lower trigger temperatures, non-solder type sprinklers are less subject to corrosion. Materials used in their manufacture resist it. In locations where they may be brought almost up to their trigger temperatures in the absence of a fire, there is no weakening of their seals against water flow.

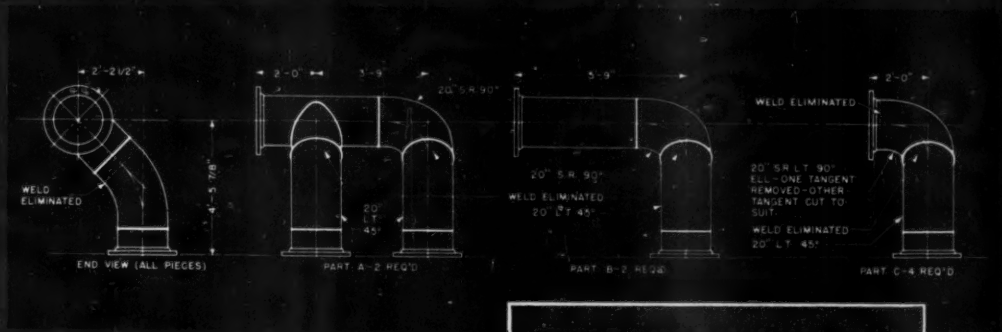
In addition to standard sprinklers there are special types. Among special-purpose sprinklers are open, sidewall, corrosion-resistant, window and cornice. Refer to the standards for these types.

Piping. Largest pipe generally used in sprinkler systems, for vertical risers, feed mains, cross mains or branch lines, is 6 in. This size can feed up to 150 sprinklers for extra-hazard occupancies, or 250 heads for ordinary-hazard. Where less than the maximum number of heads are to be fed from one horizontal pipe, size need be only that called for in the standards. Fig. 6 shows how to calculate pipe sizes easily for window sprinklers. See rules for other types. In spaces where appearance calls for an unobtrusive installation of sprinklers the quartzoid ceiling sprinklers that extend only 1 in. below ceiling may be fed from concealed piping.

Before installing new sprinklers or remodeling existing equipment, complete working plans of the piping should be submitted in triplicate to the governing authorities. Show all piping, heads, hangers, drains, test and flushing connections, type of alarm, location of control valve and all other essential features of the piping system. In addition, complete details of the building should be given on the plans.

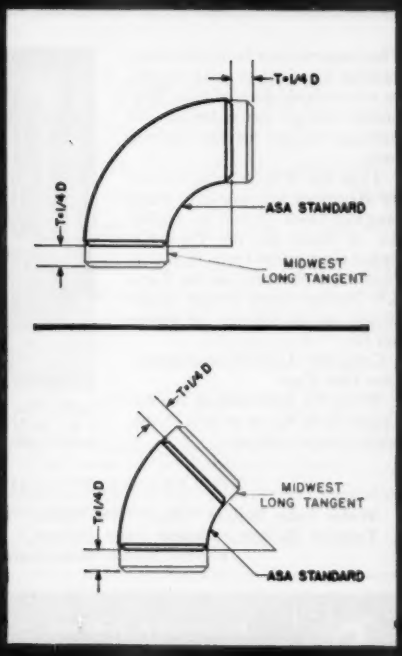
Sprinklers can make both fireproof and non-fireproof buildings fire-safe. Performance records maintained by the National Fire Protection Association show that efficiency has been better than 96% for over half a century in all types of occupancy and construction. The reason? Shakespeare said it this way: "A little fire is quickly trodden out, which, being suffer'd, rivers cannot quench."

12% COST REDUCTION.

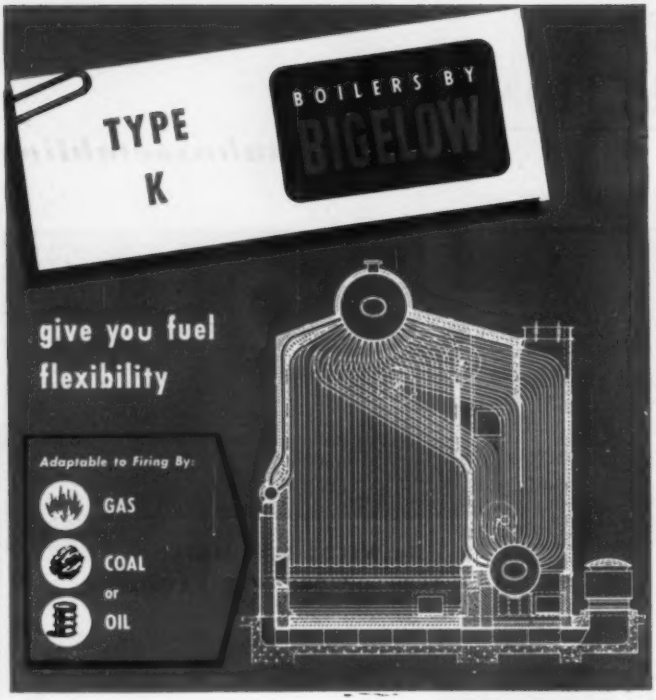


with MIDWEST

"LONG TANGENT" ELBOWS



MIDWEST WELDING FITTINGS
Improve Piping Designs and Reduce Costs

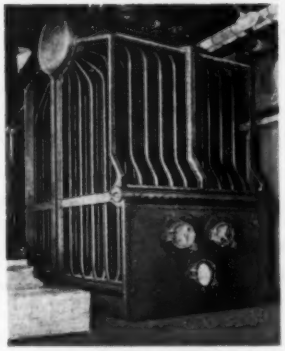


The construction facilitates conversion from oil to coal or coal to oil with minimum cost. The boiler design provides ample furnace volume for the various fuels.

Type KS Water-Tube Boilers By Bigelow are built in sizes ranging from 20,000 to 45,000 lbs. of steam per hr. Type KL Boiler sizes range from 35,000 to 70,000 lbs. of steam per hr. Type KV Boiler sizes range from 70,000 to 100,000 lbs. of steam per hr.

Compact—Low Maintenance—Low Fuel Cost.

Write for free catalog on the Types KS & KL or on any of the boilers listed below.



Bigelow Type KS-18 during erection at the E. & J. Gallo Winery, Modesto, Calif. Capacity 26,000 lbs. steam per hr., oil fired.

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Water Tube Boilers — Bent Tube Types • Horizontal Return Tubular Boilers • Scotch Type Boilers • Two-Pass Boilers Electric Steam Generators

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BI 5

More POWER NEWS

Begins on page 156

Record Economy Shows at Schiller

Extensive tests on the Schiller mercury-steam plant of the Public Service Co of New Hampshire in Portsmouth show a Btu consumption of 9106 per kwhr at 43,170-kw load when burning oil. This is 105 Btu better than the guarantee of General Electric Co, manufacturers of the units.

While the figures are preliminary, it is not expected that any major changes in results will appear. President Avery R Schiller of Public Service states that the tests prove beyond reasonable doubt that this is the most efficient plant of its size in the world.

Largest Gas Turbine on Order

Sale of the largest gas turbine-generator yet ordered for the commercial generation of electric power was announced recently by D W R Morgan, vice-president of the Westinghouse Electric Corp at South Philadelphia, Pa.

The unit, a 15,000-kw machine, will be installed in the Bartlesville area of the Public Service Co of Oklahoma. Natural gas from the Oklahoma fields will provide the heat energy the new turbine will convert into electrical power. It is scheduled for delivery from the Westinghouse Steam Division in about three years.

The 700,000-lb turbine-generator installation will consist of the gas turbine as the primary source of power, driving a hydrogen-cooled generator. The gas turbine operating at 1350 F will comprise high- and low-pressure turbines driving high- and low-pressure compressors, respectively, with the high-pressure turbine also connected to drive the generator. Intercoolers will reduce the temperature of the compressed air between stages of compression, and a regenerator will apply exhaust-gas heat to the air before it enters the combustor to reduce fuel consumption.

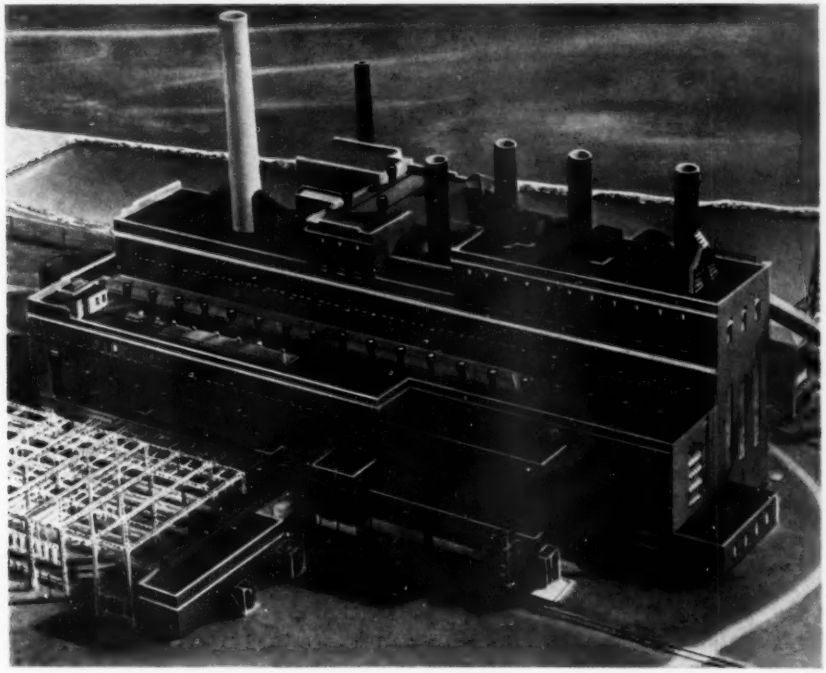
Sinclair Bids For Inventors

At the recent opening of a new multimillion dollar petroleum research plant at Harvey, Ill., P C Spencer, president of the Sinclair Oil Corp, made a definite bid for the American inventor's help.

Americans have always been inventive. In the country's earlier days an amateur mechanic or scientist could invent and prove a device in his attic, basement or garage. That's the way Henry Ford, the Wright brothers, and hundreds of others did it.

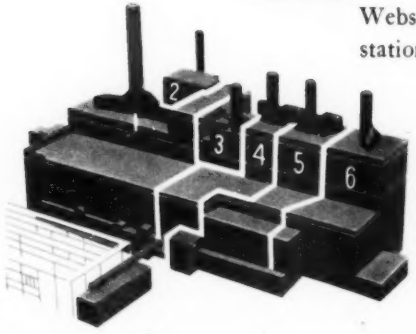
Today, though, an idea needs time to develop, the help of specialists, and considerable equipment to be proved. At Sinclair Research Labs the American inventor can find the help and equipment he needs.

All the company asks is that the Ameri-



THIRTY YEARS OF STEADY GROWTH

Since 1920, five additions have been made to the original South Meadow Station of the Hartford Electric Light Company. Many notable pioneering steps in the design of power facilities have been incorporated in this famous plant. Stone & Webster Engineering Corporation was retained for the entire station, including the latest 45,000 kw turbo-generator unit.



1 · **1920** — original station built on the South Meadows, Hartford, Conn.

2 · **1927** — the first commercial mercury turbine was installed at this plant — a bold advance in the development of power.

3 · **1930** — extension included one more steam unit bringing the capacity of the station to 90,000 kilowatts.

4 · **1937** — installation of a 45,000 kilowatt high pressure unit.

5 · **1942** — second 45,000 unit went into operation just in time to meet war needs of vital industries.

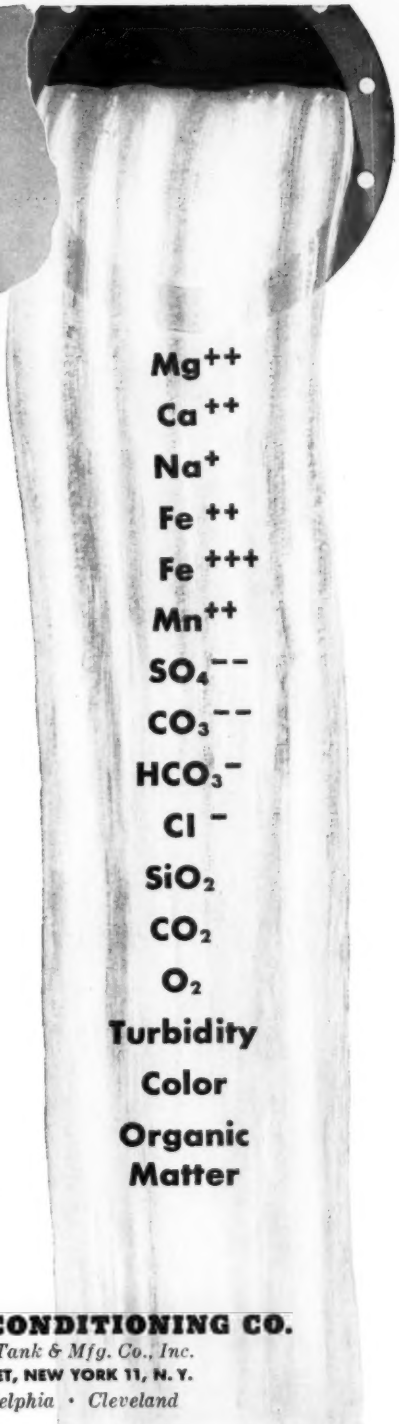
6 · **1949** — extension was built to house #6, the third 45,000 kilowatt high pressure unit to keep pace with area's expansion.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

GRAVER

can eliminate all these impurities from water...



Are any of these impurities causing plant shutdowns . . . equipment failures . . . high production costs?

Graver can eliminate any or all of these impurities from your water supply . . .

. . . because Graver manufactures *every type* of water treating equipment . . . hot and cold process softeners . . . cold and hot zeolite softeners . . . demineralizers . . . deaerating heaters . . . filters . . . chemical feeders . . . combination systems.

. . . because Graver brings complete research, laboratory, pilot plant, process development, equipment designing, manufacturing and erection facilities to bear on the solution of individual water-treatment problems.

. . . because Graver has a 40-year record of *pioneering* in the advance of water-treatment processes and the development and improvement of water-treating equipment.

. . . because Graver has many thousands of *successful installations* to prove the correctness of Graver recommendations and the effectiveness of Graver processes and equipment.

Graver provides authoritative advice on the most modern proven methods and designs for solving your particular water treating problem. Send sample of your raw water supply for *free analysis* and recommendations without obligation.

GRAVER

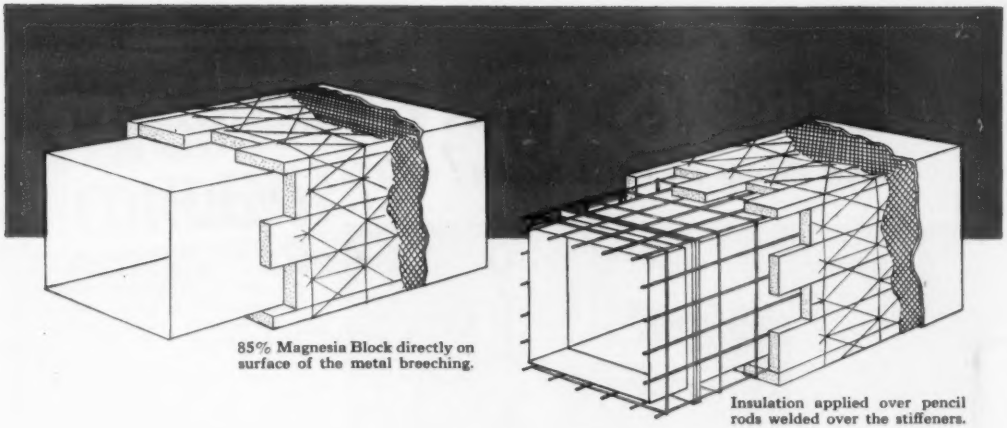
GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

216 WEST 14TH STREET, NEW YORK 11, N. Y.

Chicago • Philadelphia • Cleveland

GW 434



85% Magnesia Block directly on surface of the metal breeching.

Insulation applied over pencil rods welded over the stiffeners.

WE HAVE BEEN ASKED:

"Is it necessary to have an air space between a metal breeching and the 85% Magnesia Block covering it?"

A letter we received a short time ago posed this question—"A metal breeching recently put up in our power plant carries gases at temperatures between 500° F. and 550° F. from our boiler to the economizer. We are going to cover the breeching with 3" 85% Magnesia Block. Would you advise leaving an air space between the insulation and the breeching to prevent heat from scaling or disintegrating the metal?"

Our answer pointed out that recent studies have proved that an air space makes little difference in the temperature of the metal. The design of the breeching is the thing that determines whether or not an air space is recommended. If breechings are free of exterior stiffeners, expansion joints, and other raised parts, the Magnesia block can be applied directly to the metal, wired in place, and finished with insulating cement. However, this condition usually exists only on very short runs or moderate temperature ducts.

If the breeching has expansion joints or stiffeners, V-ribbed metal lath or pencil rods should be welded across the raised parts to provide a flat surface for the insulation.

This method spreads expansion and contraction evenly along the entire length of the breeching and guards against the appearance of unsightly cracks in the plaster finish.

When you have a problem involving insulating materials and insulation methods, call on Armstrong for advice. Over the years, our nation-wide contracting organization has discovered the right answers to just about any insulation problem. Remember, too, that this nation-wide organization offers you a complete insulation service, including good materials and trained construction men to apply them.

SEND US YOUR QUESTIONS: If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write us. We'll do our best to give you a practical answer. Just address a letter or post card to Armstrong Cork Company, Heat Insulation Dept., 7006 Maple Avenue, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

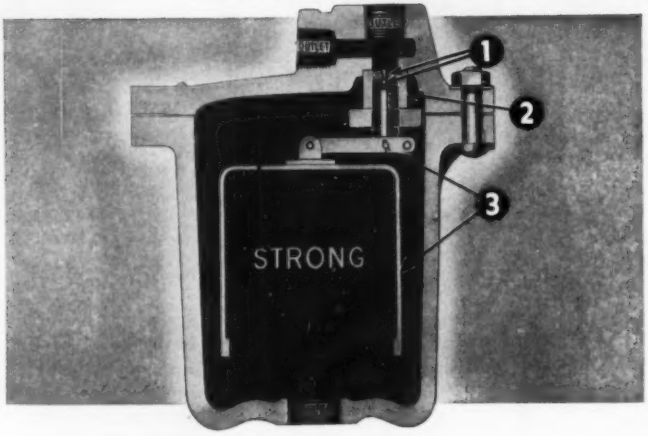
MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2600°F.

3 Reasons

STRONG* Traps

are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68-P describes inverted, open bucket and other types of STRONG traps. Write today.

*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve | 70 Series Trap | "SY" Strainer

STRONG

More POWER NEWS

Begins on page 156

can with an idea first protect himself with a patent. If Sinclair accepts the idea they will push it through to an answer. In exchange the company wants the privilege of using the invention free of royalties.

Utility Joins GE In Conference

Ways that industry can boost output to meet the present crisis was the theme of a series of six industrial electrification conferences held in April under the joint sponsorship of the Public Service Electric and Gas Co of N. J. and the General Electric Co.

The all-day forums were held in six New Jersey cities. Key production and maintenance men representing New Jersey's major industries attended. Representatives of the sponsoring companies discussed latest machinery and methods in the fields of industrial lighting, materials handling, power distribution, drives and controls, and maintenance.

Defense Program For Materials Control

National Production Authority administrator, Manly Fleischmann, announced a Controlled Materials Plan (CMP) for industry, to take effect beginning July 1.

The electric-utility and power-equipment makers face no great change since they are already under a materials program covering aluminum, copper and steel.

The new CMP is based on the World War II model right down to terminology and form numbers. Most items of heavy power equipment are on a tentative "B" list firmed up May 1.

Tennessee Clears Boiler Rules

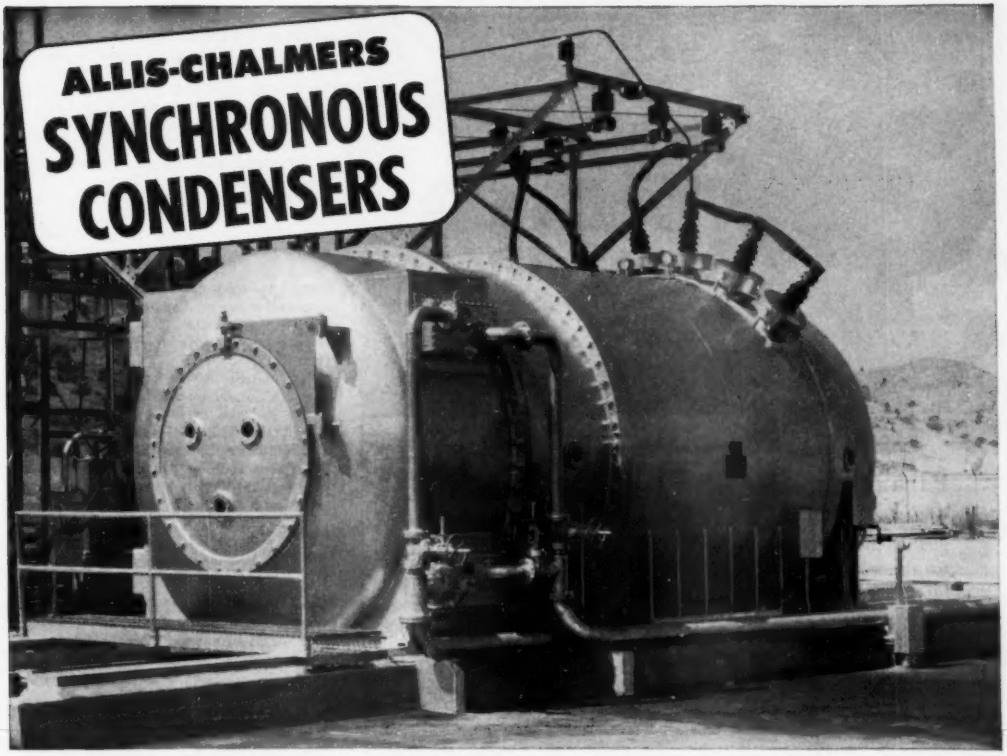
Tennessee boiler rules have been clarified by the Board of Boiler Rules, appointed by Gov Gordon Browning. This puts at ease much of the confusion existing among owners. As stated, there is no age limit on boilers of proper construction. The rule provides an age limit, though, of 30 years on those of lap-rivet construction that carry over 50-lb pressure. This latter limit will be enforced only with the approval of the board.

The division of boiler inspection, which began functioning in January 1950, has made 7500 inspections, it was stated by Lynn Peal, chief boiler inspector.

Tennessee, by action of the State legislature, has adopted the *Unfired Pressure Vessel Code*, bringing it in line with other states.

Bureau Raises Oil-Shale Estimate

Recent sampling of the Green River oil-shale formation in northwestern Colorado, where the Bureau of Mines is mining shale



Southern California Edison Stabilizes Transmission System

With Allis-Chalmers Hydrogen-Cooled Synchronous Condenser

THIS 40,000/16,800 KVA HYDROGEN-COOLED SYNCHRONOUS CONDENSER supplies reactive kva to regulate voltage and stabilize the far-flung transmission lines of Southern California Edison. It is one of several similar Allis-Chalmers machines built and building for large power systems with relatively long transmission lines. All are custom built to fill system requirements and incorporate proven Allis-Chalmers features which assure long service life and low operating cost.

Whatever problem you may have in electrical power generation, distribution, control or regulation, your Allis-Chalmers representative can help you. For further information on Allis-Chalmers synchronous condensers, write Allis-Chalmers, Milwaukee 1, Wis., and ask for Bulletin 05B7285. A-3345

ALLIS-CHALMERS

Packaged Boilers Deserve Good Fans, Too!

The same engineering talents and the same careful construction go into the many stack supporting draft fans we have designed for the so-called "packaged" boilers. In some ways, engineering faces more difficult design problems because of the utmost efficiency required in a relatively small space.

Green Stack Supporting Draft Fans are practical, too. They are readily accessible for inspection and maintenance. Shafts and wheels are removable endwise without disturbing the stack or other structural members.

To those manufacturing "packaged boilers" or to those operating them with fans that don't seem to be doing the proper kind of a job or where maintenance seems too high, we offer the services of our experienced fan engineers to (1) design fans suitable for the boiler or (2) study the problem and recommend the remedy.

Our New Bulletin 168 gives details of our Stack Supporting Draft Fans. Write for a copy.

THE GREEN Fuel Economizer COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

More POWER NEWS

Begins on page 156

and producing shale oil on a demonstration scale, has substantially increased previous estimates of shale deposits in this area.

On the basis of sampling and assay data obtained since 1944, a Bureau of Mines report released by Secretary Chapman says that partly blocked out and geologically inferred shale running 25 gal a ton or more in the richest area would theoretically yield 125 billion barrels of oil, the actual recovery depending on mining and processing losses. Combined with deposits of 15-gal-a-ton shale, the theoretical yield in the entire area rises to 494 billion barrels.

The Green River formation in northwestern Colorado covers about 2590 square miles and the Piceance Creek basin between the Colorado and White Rivers, where all sampling was done, covers about 1650 square miles. About 1000 sq mi in the basin is believed to contain shale of possible economic importance.

COMING EVENTS

June 4-8—National District Heating Assn, 42nd annual meeting, Hotel Statler, Detroit, Mich. John F Collins, Jr, 827 N Euclid Ave, Pittsburgh 6, Pa.

June 11-15—American Society of Mechanical Engineers, summer meeting, Royal York Hotel, Toronto, Ont. O B Schier, meeting mgr, ASME, 29 W 39th St, New York 18, N. Y.

June 25-29—American Institute of Electrical Engineers, summer meeting, Royal York Hotel, Toronto, Ont. R S Gardner, asst to secy, AIEE, 29 W 39th St, New York 18, N. Y.

June 25-29—American Society of Mechanical Engineers, Oil and Gas Power Div, Baker Hotel, Dallas, Texas. O B Schier, meeting mgr, ASME, 29 W 39th St, New York 18, N. Y.

British School On Gas Turbines

LONDON: *McGraw-Hill World News*—Britain's School of Gas Turbine Technology at Farnborough, Hampshire, is to hold two special international courses this summer for overseas engineers.

Both courses will last three weeks and will deal with the design and application of gas turbines for all purposes on land and sea and in the air. The first starts on May 27, and is timed to coincide with the early part of the Festival of Britain. The second course, starting on September 16, has been arranged to follow the Farnborough air display of the Society of British Aircraft Constructors.

The School of Gas Turbine Technology, which was founded in 1944 at Lutterworth in the workshops where Sir Frank Whittle

TRADE PAPER EDITION
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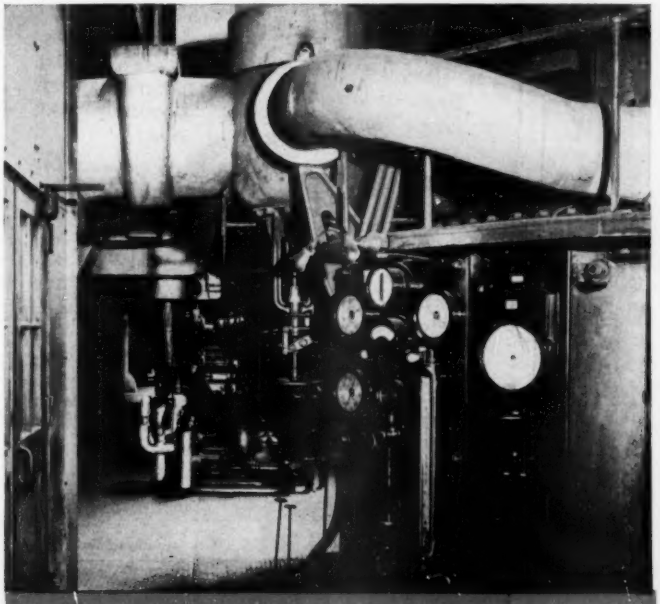
ENGINEERING News

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT • HYDROMETERS • FLOW INDICATORS • RADIATOR TUBES • VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

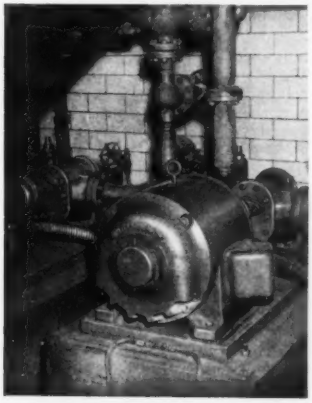
SK HIGH PRESSURE VALVES FACE LIFE AT 40

FOR almost 40 years, three SK Inverted Turbine Throttle Valves have been performing efficiently with minimum maintenance at the Schuylkill Station of the Philadelphia Electric Company. They are still going strong. When the valves were installed, force for tripping was based on a differential area closing piston. Today, SK Valves of modern design are provided with springs for tripping. The particular valve shown in the close-up, one of the three, has a 14" inlet and two 10" outlets. It is located on the steam header to a 14,000 kw Turbine and passes 325,000 lbs. per hour of steam at 220 psi. Each of the three valves serves one turbine. This long-life installation is typical of SK equipment. Over the years, we have accumulated a file of testimonials from SK customers satisfied with the efficiency and durability of SK Valves. We feel this justifies the SK policy that equipment, designed and built, not to meet a price, but to perform efficiently over a long period of time is the most economical in the long run. There are SK Valves to meet *your* needs. *Write for Bulletin* 8D.



Efficiency and Economy Keynotes of SK Gear Pumps

Rugged pumping problems dictate soundly engineered pumps constructed of durable materials to insure long life and minimum



maintenance. SK Gear Pumps are just that! Take for example this New England power plant installation. The two pump sets pictured are each required to handle 40 gpm of No. 6 fuel oil at 860 rpm against 230 psi. Since the day they were installed, these pumps have built up an impressive continuing record for efficient and economical operation.

Built in any practical material, SK Gear Pumps will handle liquid free from solids in capacities up to 1000 gpm, and pressure to 3500 psi.

Schutte and Koerting Company maintain high standards of quality in all Gear Pumps by the strictest supervision of each step in the manufacturing process.

Whatever your pumping requirements, investigate SK Gear Pumps which are available from stock. Write for Bulletin 17-*A.*

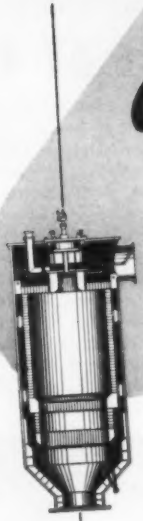
SK ROTAMETER BULLETIN

SK Bulletin 18-RA lists the various types and applications of SK Rotameters. *Request your copy.*

SCHUTTE and KOERTING Company
Manufacturing Engineers
54 CORNWELLS HEIGHTS, BUCKS COUNTY, PA.
REPRESENTATIVES IN PRINCIPAL CITIES

(*Advertisement*)

EACH PEABODY AIR HEATER *can deliver*



✓ up to 100,000,000 BTU/hr.

✓ at any pressures up to and above 250 lbs./sq. inch

The use of pressure firing to speed processing is not new but — *today*, more and more "trouble-shooting" engineers are adopting Peabody Direct Fired Air Heaters to speed, refine, and — sometimes — actually *save their process, product, or plant!*

Here's why — Peabody Direct Fired Air Heaters are *compact, adaptable, flexible* (over a wide operating range) and each one is *custom-engineered to your job specifications!* Peabody units are used for spray drying of detergents, food products, and chemicals; for tunnel drying, fume abatement, catalytic petroleum refining, rotary drying, and many, many other applications of vital importance to industrial leaders. An opportunity to help on your problem will be sincerely welcomed.

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ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N.Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers.

759

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PEABODY LIMITED • LONDON, S.W.1, ENGLAND

✱ *Write for Bulletin 600-A*

More POWER NEWS

Begins on page 156

and his team carried out their early experiments with jet engines, moved to new premises at Farnborough, Hants, last October.

Students from America, Canada, South Africa, France, Argentine, Belgium, Spain, Italy, Israel, India, Pakistan, Sweden, Denmark, Norway, Switzerland and Turkey have attended previous international courses.

Europe Studies Power Interconnection

PARIS: *McGraw-Hill World News*—After months of tough negotiations, a general headquarters for waging war on Western Europe's No. 1 industrial bottleneck—the nagging power shortage—has been set up.

This GHQ of Western European power, called the Union for the Coordination of Production and Transportation of Electric Power in Europe, unites representatives of private and state power producers and distributors, as well as of member governments. It will be independent of the Organization for European Economic Cooperation (OEEC), but will work closely with it.

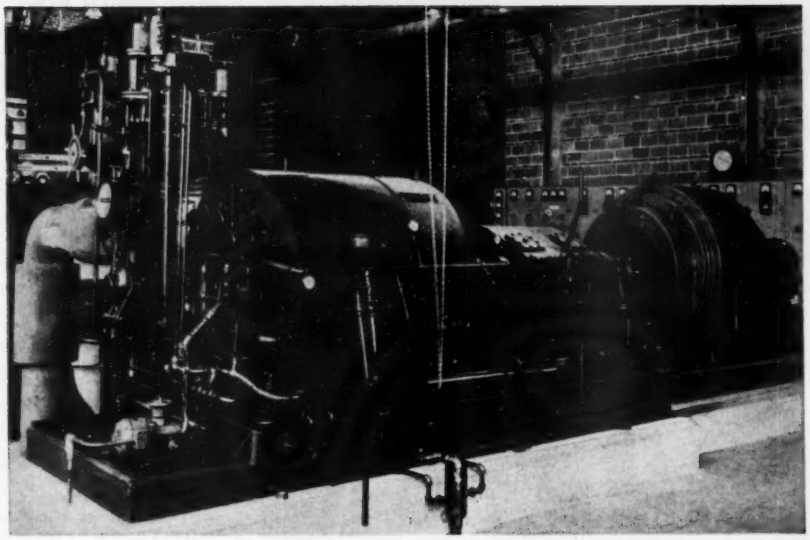
Goal of the Union is to achieve maximum interconnection among national power systems across frontiers; maximum efficiency of local interconnections within national systems. This will enable neighboring power systems to share each other's surplus output. It will reduce the cost of power, as well as in effect increase total output through more efficient use of existing capacity.

An idea of the importance of international connections in Western Europe is indicated by the fact that France alone wastes 25% of its annual power production—four billion kwhr out of a total of 33 billion kwhr—because of seasonal production peaks corresponding with demand troughs. Interconnections, which would make it possible for France to export power during peak production and import it during peak demand, would cut this loss sharply.

It is estimated unofficially by OEEC electricity experts that the Union may be able to make as much as 8% more total power available to Western Europe within two years through the increase of international interconnections.

Foster Wheeler Corp will furnish a 1,200,000-lb-per-hr normal continuous-rating pulverized-coal-fired steam-generating unit for installation in the East River Station of the Consolidated Edison Co of New York. The unit will be of reheat, dual-circulation type designed to deliver steam at 1850 psi, and of 1000 F with 1000 F reheat. Steam temperature will be maintained constant over the range from 500,000 lb per hr to full load.

Cummins Engine Co, manufacturers of diesel engines, are urging their customers to set up complete and adequate pre-



Proved Turbine Economy

AT NARRAGANSETT BREWERY

For the past twenty years this Rhode Island brewery has been growing — and incidentally proving out turbines in its plant.

The first Terry Turbine was bought in 1936 and enabled the brewery to take full advantage of power generation as a by-product of its process steam.

One of the latest Terry Turbines installed in this plant is shown above. It is a 1000 kw mixed-pressure bleeder condensing turbo-generating unit. Initial steam is 265 pounds with 70 degrees superheat. Process and heating steam is bled at 22 pounds. Any steam not needed for process, passes through the low-pressure stages to the condenser. So if there is an excess of low-pressure steam from the high-pressure section of the turbine or from other sources, it is automatically admitted to the turbine and converted into power.

With other Terry units it provides great flexibility in power available, full stand-by capacity, low cost power and excellent automatic heat balance with ample clean steam, at low pressure, for such functions as kettle boiling, washing, bottling and heating.

Evidently these Terry Turbines have performed economically — altogether six were bought in 1936, 1940 and 1946.

A Terry installation may be as profitable for you as in this plant. We will be glad to discuss the possibilities with you.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

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VALVES

Pressure Seal Bonnet Gate Valve

for High Pressure, High Temperature Service

● R-P&C pressure seal bonnet joint is tight under varying service conditions—is easy to disassemble for inspection—reduces weight.

R-P&C compensating wedge will not stick—opens and closes easier than solid wedge—assures tightness under minor line strains.

Ask your R-P&C *representative to explain the details of these valves*

ACCO
Chicago, Philadelphia, Atlanta, Baltimore, Boston, St. Louis, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

"Intentionally Better"
READING-PRATT & CADY VALVES

More POWER NEWS

Begins on page 156

ventive-maintenance programs. The company is supplying Cummins diesel owners with a service bulletin, *Protective Maintenance Increases Profits*, as a guide for such a program.

Minneapolis-Honeywell Regulator Co has completed arrangements for consulting services to the Atomic Power Div of Westinghouse Electric Corp. Under the agreement Honeywell engineers will act as consultants in valve problems arising in the Westinghouse program.

Taylor Instrument Co celebrates its 100th birthday of business in 1951. Although instruments for consumer use comprise the oldest part of the present line, the largest is the industrial instrument division, which began in 1896.

Pennsylvania Salt Mfg Co has formed a special sales department to serve industry and business in maintenance work, from heavy-duty cleaning of railroad equipment to cleaning walls and floors. The department will be known as the Maintenance Chemical Dept.

Gordon Research Conferences, sponsored by the American Assn for the Advancement of Science, will be held June 18 to Aug 31 at New Hampton School, New Hampton, N. H. Theme of the conference will be research on ion exchange.

Morton F Leopold, in charge of motion picture production for the **Bureau of Mines** for over three decades, received a gold medal for distinguished service from James Boyd, director of the Bureau and Defense Minerals Administrator on behalf of secretary of the interior, O L Chapman.

I W Cotton, president of the I W Cotton Co, has been appointed chairman of the committee on research of the **American Society of Heating and Ventilating Engineers** for 1951. This committee plans and supervises the society's research program at its laboratory in Cleveland and at cooperating colleges and universities.

Cooper-Bessemer Corp received an engine contract to build 40 of its largest supercharged gas engines for Reynolds Metals' new giant aluminum reduction plant to be located near Corpus Christi, Texas. Deliveries are to start in August and be completed by January 1952.

Frank J McDevitt, president **St. Louis Board of Public Service,** has submitted a plan for generating electricity from waste gases from the city's proposed rubbish incinerators. The plan embodies gas-turbine generating units.

Narragansett Electric Co of Providence, R.I., petitioned the Westerly, R.I. zoning board for permission to build a 5000-kw diesel-generating plant there. The cost is estimated at a million dollars.

available to solve slime problem
Santophen 45, a new Monsanto chemical, is available *now* in quantities you need to control bacterial and algal slime in cooling water. It is particularly effective in cooling waters acidified to pH 5.5 to 6.5.
With *effective* Santophen 45 readily available, you no longer have to depend upon hard-to-get chlorine, sodium hypochlorite, sodium pentachlorophenate and other slime-control agents. Used in combination with these "tight" chemicals, Santophen 45 helps stretch your supplies and gives you effective control over a wide range of microorganisms.
Santophen 45 (sodium trichlorophenate, technical) helps extend the interval between mechanical cleaning of condensers and makes cleaning easier. Santophen 45 is economical to use. It helps maintain high efficiency in cooling systems.
To adequately control slime at your plant use Monsanto Santophen 45 . . . a chemical you can be sure of getting. For a test sample, quotations and technical information on Santophen 45, contact the nearest Monsanto Sales Office or write MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Mo.
Santophen: Reg. U. S. Pat. Off.
MONSANTO
CHEMICALS — PLASTICS
SANTOPHEN 45 has been used in the cooling tower at the John F. Queeny Plant of Monsanto Chemical Company for more than two years. It has been proved highly effective here and in other cooling towers with capacities up to 600,000 gallons.
DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

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TUBE CLEANERS

Deliver all the

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you need for

QUICK RESULTS

ROTOJET® Water-driven Tube Cleaners provide power heretofore obtainable only with air-driven equipment. A vast increase in power and a material reduction in water consumption were achieved through radical design changes based upon latest research in hydrodynamics.

The new ROTOJET removes the hardest scale much more quickly and efficiently than ever before possible with water-driven equipment. Send for new ROTOJET Bulletin.

C321 ROTOJET Water-driven Motor with short 4-arm head and universal joint for 2¼" I.D. straight tubes.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

More PLANT PROBLEMS

Begins on page 138

TWO OSCILLATIONS. Longitudinal or rotational oscillations may be cured by increasing the load inertia or machine inertia or by increasing the damping in the governor.

Axial oscillations are also caused by misalignment between bearing's center and magnetic center, faulty thrust bearing or gear. Oscillations will not impair electrical operation of machine but will damage turbine bearings if connected direct. Check bearings and reduce bearing end play.

Rotational oscillations may be due to electrical hunting which, though undesirable from the system's point of view, will not damage machine. Increase in machine inertia or application of damper circuits would reduce oscillations. Cure by adjusting the system's electrical constants, notably the resistance. Avoid oscillations by operating at a different load or excitation level.

G G Weir *Milwaukee, Wis.*
Allis-Chalmers Mfg. Co.

NOT LEVEL. Check the generator's level. A machine that's not mounted on an absolutely level plain often tends to vibrate axially. Once started, these vibrations are hard to damp out. This is especially true of high-speed machines, where a slightly unlevel mounting might cause a lot of vibration.

While there's a slight chance this may be due to a harmonic circulating current, this possibility seems very remote. I doubt very much that the vibrations are electrically created.

D H Noble *Wilmington, N. C.*

MARMADUKE

Continued from page 150

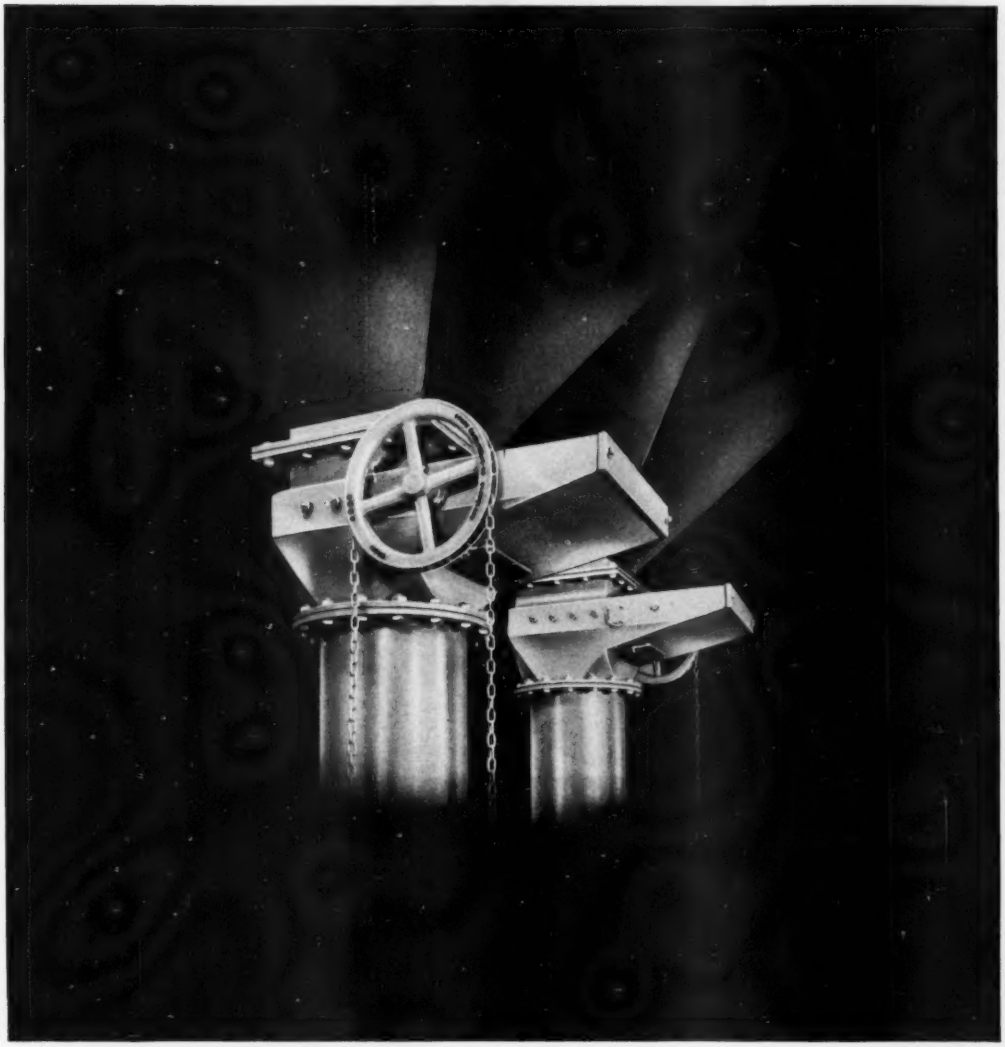
one of those sand storms blew up. We battened down engine and fireroom hatches and ventilators to keep that fine red Arabian sand out of the bearings. With no ventilation, the fireroom handrails blistered your hands. The engine room yelling for steam, added to poor firing in that heat, made every four hours watch really rough.

"The stokers had just enough steam after a watch to draw themselves up the fireroom ladder. Then they tumbled down on a hatch while chills from that heat ran up and down their spine.

"One stoker did pop his rivets. When he got up on deck and saw that cool water over the side, he jumped overboard to cool off. That put him out of his misery fast.

"We got through the Gulf of Aden

S-E-Co. Coal Valves Don't Stick



S-E-Co. Coal Valves don't stick because they are made with double racks and pinions. This design moves the gates squarely without binding. Furthermore, **S-E-Co.** Coal Valves are equipped with a U-shaped gate that places the supporting rollers and racks in side compartments away from contact with coal. As a result the operating parts are not subject to clogging or corrosion.

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Insist on Darts. You'll find they *cost* less in the long run.

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and into the Indian Ocean. In Karachi seven weeks after leaving Philly, I demanded new grates. 'I'll buy a hundred in Shanghai and save three hundred dollars,' argued Donovan. Then added, 'If we got this far, we can last another five weeks'.

"We made Bombay, Penang and Colombo, then headed for the Straits of Malacca. I was ready to jump ship myself by then. Any thick-headed stoker could tell we were wasting fuel because of those bum grates.

"In Singapore we lost more firemen, so I picked up three beachcombers. Leaving Saigon in French Indo-China, the captain said he got word we'd lay a month in Shanghai. That was good news, but I was only interested in grate bars.

"Finally we entered the South China Sea and made Hong Kong. Then Foochow and a few days later dropped anchor in Shanghai.

"In Shanghai, the English ship chandler promised to have the foundry cast one hundred grate bars and have them aboard in a week. But Donovan was cagey. He wasn't satisfied with his rakeoff on the deal. So he spent the first day ashore, looking up a Chinese foundry. That afternoon he returned to the ship and had 'Charley' in tow.

" 'Here's our man, Donovan announced to me proudly. 'He'll make the grate bars and give me plenty "cumshaw," besides.'

"Donovan gave Charley our wooden foundry pattern for the bars. He explained by gestures and in detail that the grates must fit our furnaces or he wouldn't pay one Chinese copper for them. Charley smiled broadly and assured the chief, 'Me savvy—him allee samee—him allee samee'.

"Two weeks went by and the chief got to worrying about the grates. He sent an oiler ashore, who returned with Charley.

"Charley smiled when Donovan asked for a delivery date. 'By-ma-by, by-ma-by,' he assured the chief.

" 'I guess they're a little slow out here', explained Donovan and let it go at that.

"Down below I was busy with my boilers. We had removed the good grates from each boiler and put them all into the donkey boiler. I had two dozen Chinese working below for twenty-five cents American money a day. They cleaned all the boilers, both fire and water side. Then they cleaned bilges, replaced leaky gaskets, and painted out the fireroom. That gave us plenty time to go ashore and enjoy life. A dollar went a long way.

"Another week and still no grate bars. So again Donovan sent for Charley. But again Charley had the same old reassuring smile and said, 'By-ma-by, cheef. by-ma-by.' And that was that.

"Then came sailing day and no grate

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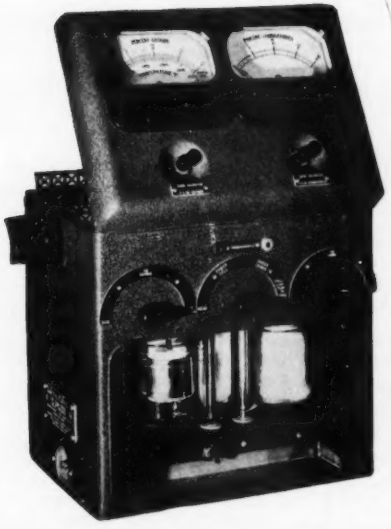
Now that the "heat's on" for record production, the calls are increasing for the services of the Cities Service Heat Prover. This scientific instrument gives an accurate, instantaneous and continuous picture of combustion conditions in all types of furnaces.

You'll readily be able to calculate any oxygen excess, waste combustible matter, and potential fuel savings. The results are like an accurate "diagram" of corrective measures needed to conserve heat units for consistently higher production at lower cost.

You'll see profit in applying the Cities Service Heat Prover . . . *not an instrument you buy, but a service we supply!* Call or write your local Cities Service office about arrangements. Or simply return the coupon today.



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Niagara "No-Frost Method" keeps frost and ice COMPLETELY OUT of your cooling, chilling, freezing or cold storage.

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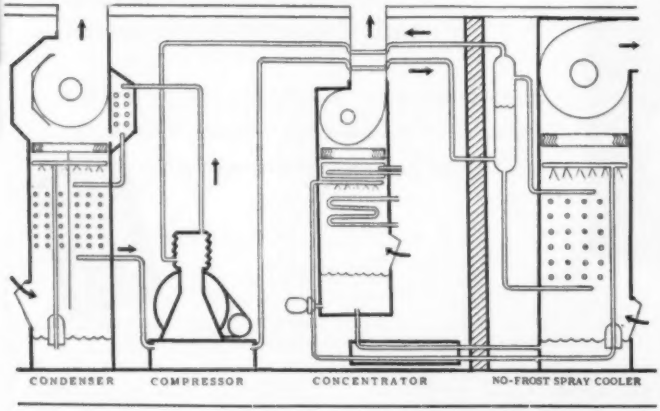
Now, a NEW design No-Frost Liquid concentrator, using a new principle, takes away moisture as fast as it is condensed by evaporating it at low temperature — not boiling it away at high temperature. It has 14 times the capacity of the old method per dollar of investment — one concentrator will handle a battery of high capacity spray coolers.

This gives you more refrigeration at lower cost; less machinery in less space. You operate at high suction pressure, saving power and wear and tear on compressors.

The extra capacity and lower cost both for equipment and operating makes this method advantageous for every type of refrigeration use — both for freezing and for moderate temperatures — for large "live" loads as in meat chilling or in fruit and vegetable pre-cooling — for rooms that are filled and emptied of product daily, such as milk rooms and terminal storage warehouses.

You get true trouble-free refrigeration . . . No brine . . . no salt solution . . . no dirt . . . no mess . . . It is entirely clean; you get rid of dirt and odors. You reduce both equipment and operating costs.

For complete information write to the Niagara Blower Company, Dept. P, 405 Lexington Avenue, New York 17, New York.



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(Advertisement)

bars. By then Donovan was ready to blow his safeties. I had to have steam up by midnight, but this time I let him do the worrying.

"Just as Donovan started down the gangplank in a rage for the foundry, who should walk up but Charley. He had our wooden pattern under his arm. There was that old grin on his puss as he pointed proudly down to a large Chinese junk laying alongside us.

" 'Look at that load of grate bars,' yelled Donovan, doing an Irish jig and rubbing his hands. 'I told you these Chinks knew their stuff. And did you ever see a neater bunch of castings?' he asked excitedly. 'And I'm making four hundred bucks for myself—wow!!'

" 'How's that for workmanship, Mr. Surfaceblow,' he asked, throwing out his chest and turning to me.

"I'll answer that question after I have them in the boilers awhile,' I answered, feeling this was too good to be true.

"The captain and the mate came down the deck just then. 'Those grate bars are a load off my mind', barked the captain, looking over the side. 'And don't be reminding me of that two hundred dollars you saved the line. All I want from you, Mr. Donovan, is to have steam up in all boilers by midnight. We'll have to turn ninety-six revolutions to make Honolulu on time'.

" 'Don't worry', Donovan assured him. Then he asked the mate to hoist the grates aboard.

"The captain, mate, Donovan, Charley and I waited for the first net load to come aboard. As the grates landed on deck, Charley walked over and grabbed a grate from the pile. He handed it proudly to Donovan—with one hand—while our eyes popped at his souped-up strength.

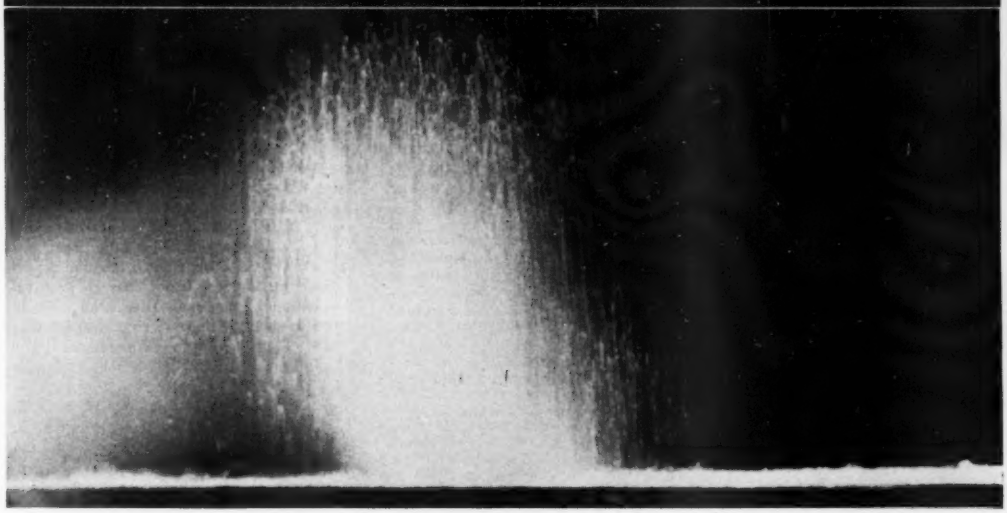
" 'See,' Charley grinned proudly from ear to ear, holding his grate against our pattern, 'Him allee samee—him allee samee!'

" 'WOOD', yelled Donovan, kicking the pile of wooden grates and getting purple around the gills. 'EVERY GOD-DAM GRATE IS MADE OF WOOD'. And they really were—even down to the gray paint job—just like our pattern."

In what is believed to be one of the largest purchases of privately owned natural-gas reserves, a group of Western industrial and investment men has been formed by **William R Staats Co** of Los Angeles to organize a new corporation for producing and developing of gas properties in the Mid-Continent. Total consideration is approximately $36,000,000. The new organization, to be known as the Hugoton Plains Gas and Oil Co, is comprised of three principal stockholders —J Simon Fluor, William R Staats Co, and Fred R Tuerk.

this is **aerosolitis**

(pronounced: air-o-sol-ite-is)



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prevent this boiler disease

Tiny drops of water dispersed in the steam—called *aerosols*—cause superheater deposits, foul turbine blades. When this happens, your boilers have aerosolitis, and costly shutdowns and repairs will result.

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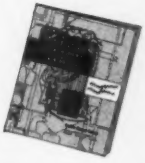

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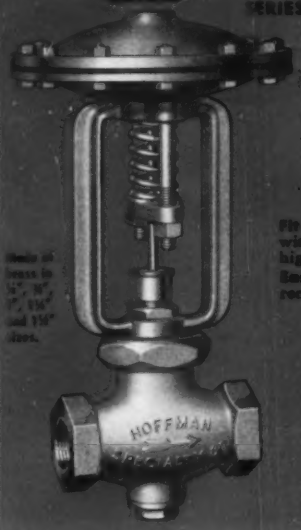

Made of brass in ½", ¾", 1", 1¼" and 1½" sizes.

Fit into tight spots—can be installed with diaphragm case above or below high pressure line.

Easily serviced—valve seat and disc renewed without removing valve body.

Economical—quickly adapted to wide variety of services, including steam, water, air, fuel oil, gasoline.

Adjustable—springs for standard ranges, 5 to 25 lbs., 20 to 50 lbs., 50 to 80 lbs.

Ideal for supplying reduced pressure to tank temperature regulators, pressing machines, rubber vulcanizing equipment, sterilizing apparatus, laundry equipment, etc. Also as a pump governor for small steam pumps.

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Easy to install—Requires minimum space—suitable for marine service.

Standard temperature ranges. Sizes ½" to 1½": 80°-140°, 100°-160°, 110°-170°, 130°-190°, 150°-210°, 170°-230°, 190°-250°.

Sizes 2" to 5": 100°-140°, 120°-160°, 160°-200°, 180°-220°.

Is self-motivated—Requires no external source of power, such as electric current, air or water pressure for operation.

Sizes from ½" to 5" ips. Cap. from 50 to 50,000 lbs. steam per hour. Standard temperature range 80°F to 220°F. Other ranges available on special order.

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More ARGUMENTS

Begins on page 144

old Mason Pump Governor except you folks. I met a couple of them back in 1927 that had been in use quite a while then. One of them did a swell job as the only governor on the speed of a steam-driven Frick ammonia compressor.

I have them on every pump of mine for the same reason that FLS need them. My pumps all have some sort of pressure or vacuum valve as well. On several occasions we have had accidents that would have allowed the pump to run away, but the Mason held it to a speed only slightly above normal. I wouldn't be without them.

And while I'm wrtiing, here are some comments on other issues. . .

. . . Phil Swain's Editorial in Dec OE, p 19, strikes a familiar note. Just now I'm trying to work out a vacation schedule for fourteen men. They all want vacations at the same time. One week in July and the rest during deer-hunting season. None seem to understand why they can't all be off without the plant shutting down. . . .

. . . And the cartoon on p 35, Jan OE, should give everyone food for thought. We're all in too much of a hurry—too careless to take the few simple precautions that would make a machine safe before working with or on it.

I have a brother-in-law to put up as a horrible example of carelessness. He's been around with one arm gone at the shoulder for several years now.

At one time he was a mechanic in a food plant. They had several paddle mixers and one day something got caught in one of them. He threw the switch and stuck his arm in. He didn't take time to look at the switch, even though it was right at hand.

Someone accidently threw the switch while he was still feeling around inside.

. . . For years I've been telling the boys about securing all valves before entering a boiler. But just a few days ago I found one of the boys inside and not only weren't the valves secured but the blowoff was open. This time I used words that he shouldn't forget for a few years—even if he forgets the valves completely.

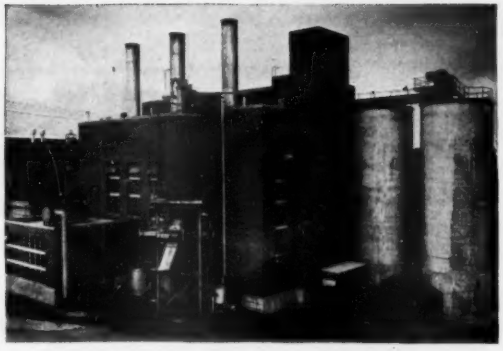
D E WRIGHT *Woodbourne, N. Y.*

Do Insurance Companies Demand Injectors?

I CAN'T QUITE understand some of the things in "City Water for Low-Pressure Feed", p 53, March OE. Mr Pile states that his boilers were operating at 20 psi. At what pressure were the safety valves set to blow?

Probably his was one of those instal-

WE KNOW
COSTS CAN BE CUT

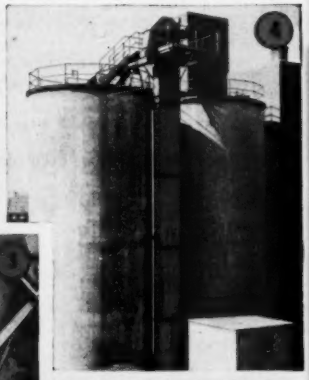


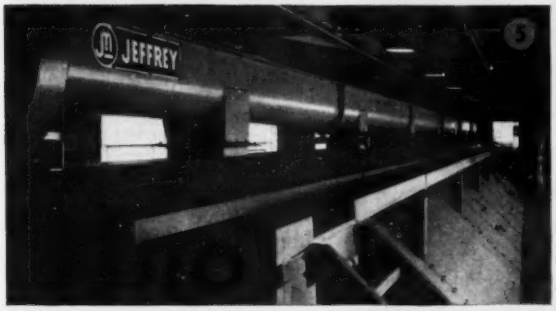
Above: Exterior view of the new plant—more modern and practicable than most.

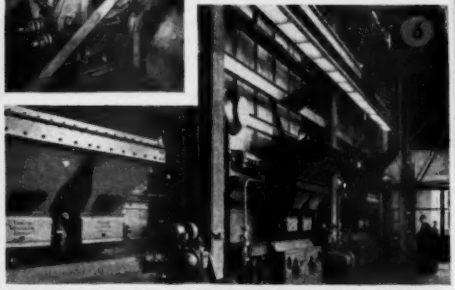
Started up almost a year ago, our NEW Steam Generating Plant (three 60,000 lb. per hr. boilers) is showing savings far exceeding expectations. Better thermal efficiency, generous savings in generating cost and reduced man-hours per year contribute to the over-all practicability of this new boiler house.

No glass house for us . . . dustless Coal Handling is provided by the use of Jeffrey equipment. Coal is speeded on its way from Track Hopper to Vibrating Feeder (No. 1) to Scraper Conveyor (No. 2) to FLEX-TOOTH Crusher (No. 3) (or by-passed) to Bucket Elevator (No. 4) to Spiral Conveyors (No. 5) . . . thence to bunkers or silo storage. All Jeffrey including the Weigh Larries (No. 6).

WE KNOW—SAVINGS CAN BE INCREASED—with Jeffrey Coal and Ashes handling machinery. Let us prove it.







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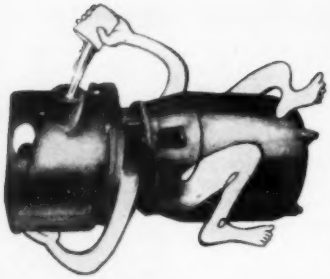

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1. **Absolutely no valves**—There are no valves of any kind in these pumps—nor are any needed in installation. Liquid can drain out of discharge and suction line through pump without affecting priming ability.
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¼ to 5 H.P. ratings, open and closed impellers. Capacities to 120 G.P.M. Heads to 135 ft., suction lifts to 25 ft. Flexible coupling, or close-cupld motor drive. Send for Bulletin 636.1.

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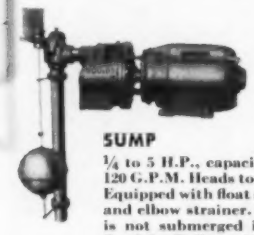

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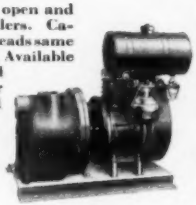

For complete information contact your nearest Goulds representative or write Pump Headquarters, Seneca Falls, N.Y.

MEMBER

Goulds PUMPS INC. Seneca Falls New York

lations where the stoker would stop on high steam as well as low water. And the operator probably had other duties along with his work of operating boilers.

I would never operate a boiler with only one source of feedwater supply. The cost of an injector is small when compared to the cost af damage done to the boiler by low water.

I doubt that the insurance company would allow a boiler to operate without an injector—even if the feedwater pump is out for only a short time. Would they?

G G AVANT *Wilmington, N.C.*

What's the Use In Licenses?

I'VE BEEN MEANING to write sooner and say thanks for the 32-page section cover-

ing license requirements in the forty-eight States, Feb 1950, OE, p 19.

And now I'd like to go along with a brother from this city of Philadelphia. A L Schnidering, Mar OE, p 53. He's right about licenses.

Isn't the license law a misnomer? It certainly isn't the license law that the average engineer would like to have. Especially not those who have followed this trade for long.

Knowing and having worked with some men who got engineer's licenses (politically, shall I say?), the majority of them wouldn't even make a pimple on a *good* engineer's fanny.

First off, they don't take enough interest to study any of the laws of physics, or the equipment in their charge—or even to subscribe to a good technical magazine.

As fellow engineer, A L Schnidering, says—"aw nutz. . . .what's the use?"

T F CUNNINGHAM *Philadelpha, Pa.*

Take Boilers Off the Line When Not Needed

IN "ARGUMENTS", p 53, Feb OE, George Spaulding's plant evidently has no steam flow meters or coal weighing equipment for if he had, the answer would be easy to find. In most boiler installations best efficiency is had at about 150 to 160 percent of rating, when not equipped with econimizers or air heaters.

Hundreds of well equipped plants across the nation cut boilers in and out every day to match the boiler capacity to steam demand. Boilers that are clean inside and out come on the line with little fuel when they are hot from operating part of the previous 24 hr. This is especially true with powdered coal, oil or gas firing. Stokers that are well selected and properly installed with

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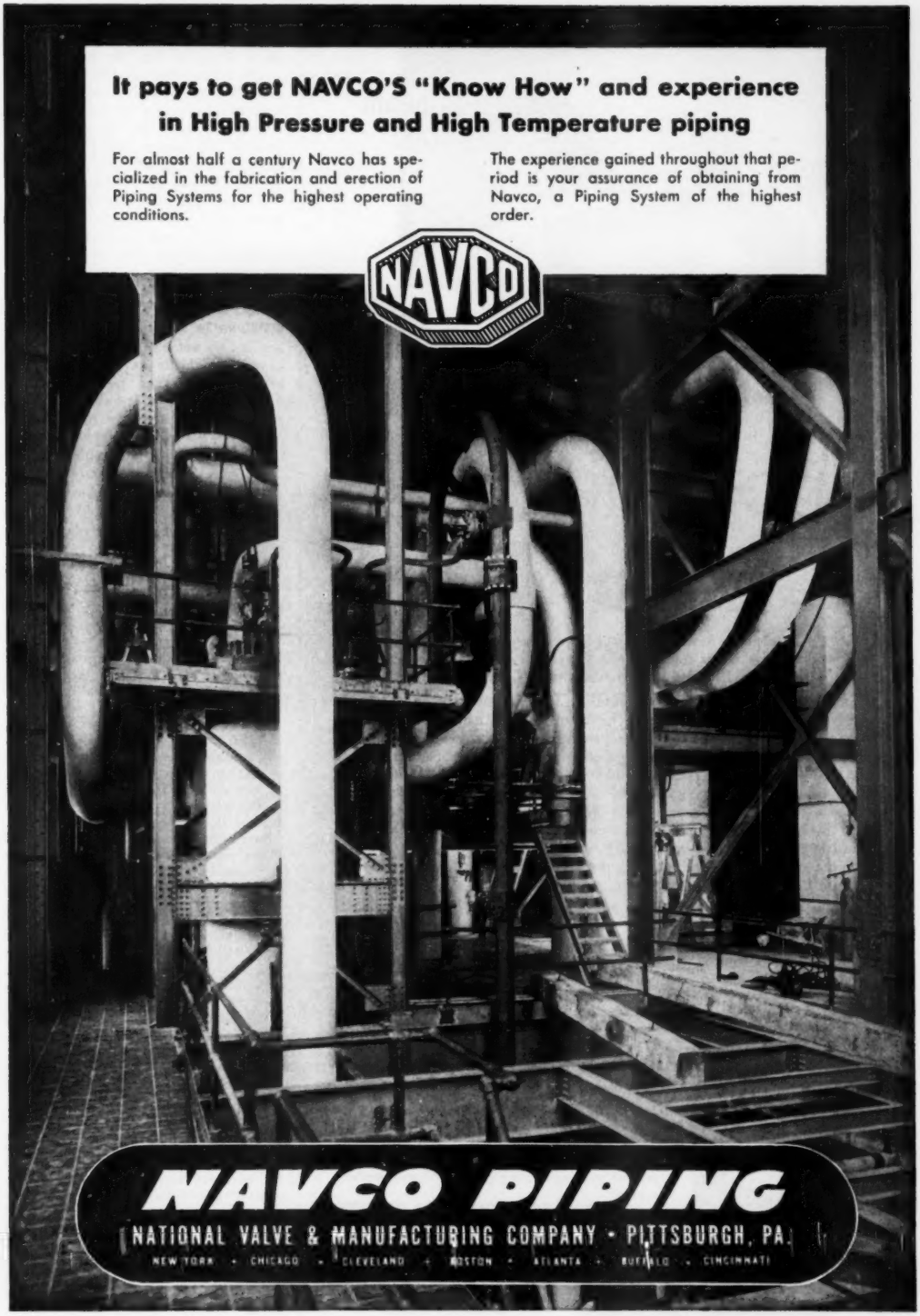
For almost half a century Navco has specialized in the fabrication and erection of Piping Systems for the highest operating conditions.

The experience gained throughout that period is your assurance of obtaining from Navco, a Piping System of the highest order.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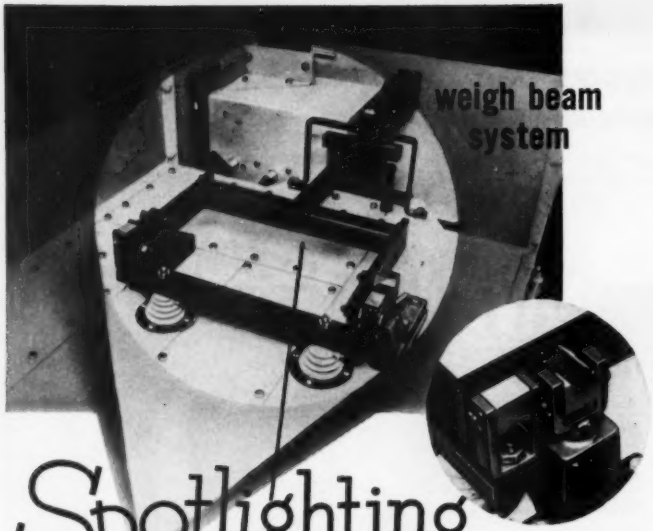


Spotlighting

ACCURACY in the **RICHARDSON** coal scale

Another reason why thousands of power installations keep an accurate check on boiler efficiency with Richardson Automatic Coal Scales.

The key to Richardson Scale's reputation for consistent accuracy lies in its Weigh Beam System—the heart of every Richardson Scale. Great strength where strength is needed, sound basic design, and precision construction enable this system to maintain an accuracy of ¼ of 1%. The unit is built of heavy, welded members, free from any tendency to warp or twist with Weigh Beam mounted on hardened steel knife edges, bearing in V-notched, self-aligning, hardened steel blocks. The system is mounted in a separate, dirt-excluding housing to reduce wear and insure long life.

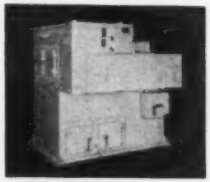
Some other important features that make Richardson Scales the standard of comparison throughout industry are:

QUICK-RELEASE BY-PASS MECHANISM for emergency re-routing of coal direct to stoker or pulverizer.

HINGED LEVELING PLATE to establish a uniform "breakaway" of coal each time the feeder belt is stopped, and to allow passage of occasional large lumps without damage to belt.

DIRECT-CONNECTED DISCHARGE COUNTER to register automatically and unerringly the number of discharges.

ALL ELECTRIC EQUIPMENT mounted outside of corrosive atmosphere of coal chamber.



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Richardson

8104 MATERIALS HANDLING BY WEIGHT SINCE 1902

ample furnace volume can also be put on or taken off the line very quickly.

Comparing steam-flow-meter and coal records shows that it does not pay to keep two boilers on the line when one is ample to carry the load. This is true even at 200 percent rating around the clock—if the furnace volume is ample for burning the fuel needed.

It works out that two sets of boiler losses are always greater than one. For instance, steam for soot blowing is certain to double with two boilers of the same size as compared to one.

One auto manufacturer's plant has 3 powdered-coal-fired boilers with a 60,000-lb-per-hr top rating each. Boilers are laid up wet if to be off for one week or more. Whistle on water column is replaced with pipe plug and boiler filled to vent below first stop valve with deaerated water from open 5-psig heater. Makeup is hot-lime soda with after treatment. Object was to completely fill boiler with deaerated water of about 11 to 11.5 pH. No corrosion has been noticeable in these boilers in five years.

SCHUYLER PAGE *Buffalo, N. Y.*

Coal Gasification Offers Low-Cost Fuel

More than two years of experiments, by the Bureau of Mines and the Alabama Power Co at Gorgas, Ala., show gases resulting from burning unmined coal may offer a low-cost fuel for power generation.

A gas turbine, driven by hot product gas resulting from underground burning of coal, operated at Gorgas for a short time. It was the first time this had happened in this country, according to Secretary of Interior Oscar Chapman.

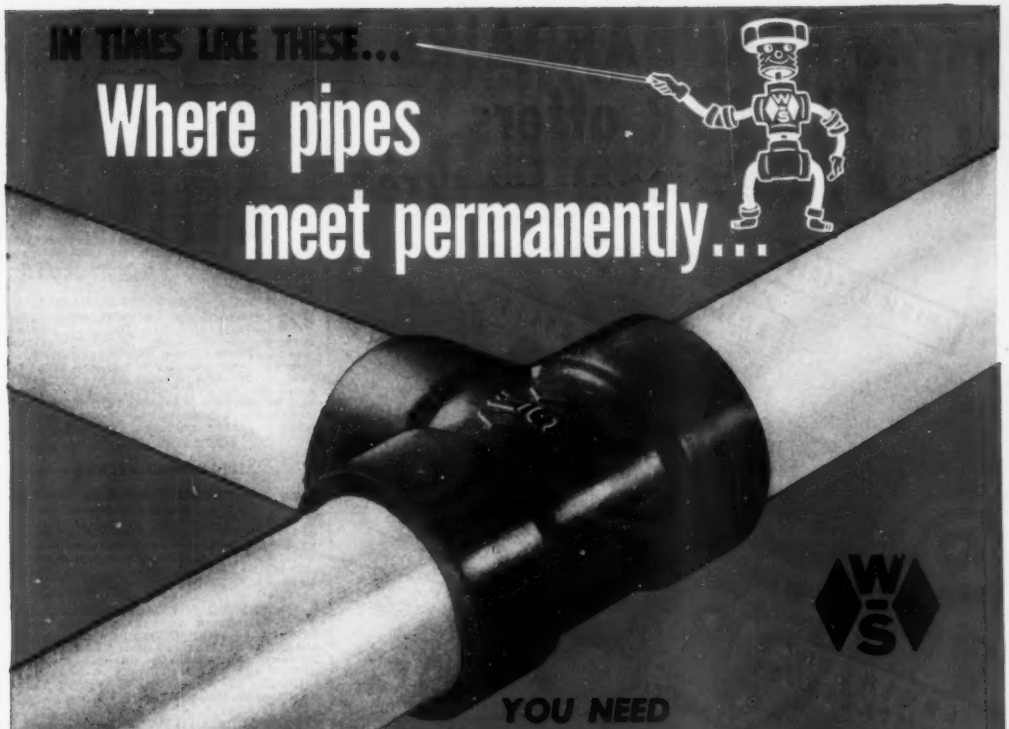
James Boyd, director of the Bureau of Mines, announced still further experiments at Gorgas. One proposal is the production of synthesis gas or hydrogen, a preliminary and relatively expensive step in converting coal to gasoline, oil or chemicals.

For this new experiment a deeper coal seam will be opened up by electrical or hydraulic methods. These methods are expected to improve contact between air and coal faces underground and permit better control. A gas of relatively high heating value (80-100 Btu per cu ft) without deterioration may be produced.

Alabama Power Co will spend $27,885,000 during this year, the largest construction budget in its history. About half the total will be for construction of new generating facilities. These include completing a 100,000-kw unit at Gorgas No. 2 steam plant, starting another 100,000-kw unit there, completing a 40,000-kw addition to Chickasaw steam plant near Mobile, and work on an additional 55,000-kw unit at Martin Dam on the Tallapoosa River.

IN TIMES LIKE THESE...

Where pipes meet permanently...



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SCREWED AND SOCKET-WELD FITTINGS

SCREWED FITTINGS . . . are designed with ample metal sections. The wall-thickness is faithfully observed in final manufacture. Extra long bands extend well beyond the last thread, providing reinforcement at points of severest strain. Threading — is long, accurately cut, and perfectly aligned to insure tight joints. All fittings are properly chamfered to protect thread and afford easy entrance of the pipe.

SOCKET-WELD FITTINGS . . . just slip over end of pipe and weld. Deep socket supports and aligns pipe, eliminates tack welding and the use of special fixtures. Accurate measuring and cutting of pipe unnecessary . . . Ample come and go. No welding icicles inside pipe — no clogged lines. Wall sections 1¼ times the nominal pipe thickness permits proper heat penetration and correctly proportioned fillet weld.

Basic materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and all are instrument inspected for perfection of threads, sockets, angles and concentricity. Write for Bulletin A3-50. For information on Stainless and Alloy Steel Fittings, Bulletin S-1.

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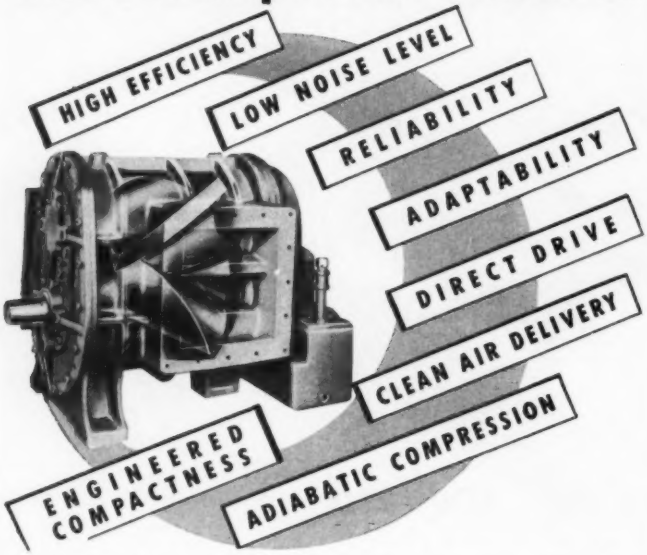
The STANDARDAIRE BLOWER offers these exceptional features



WHETHER you require 20 cfm or 15,000 cfm capacity blowers these features are inherent in the unique design of the modern Standardaire positive displacement blower. Its epicycloidal rotor form acting as an air screw is unlike that used in the conventional lobe type unit—and Standardaire blowers have demonstrated their all-around superior performance to the satisfaction of many leading industrial users.

Send today for complete information. If you have specific requirements our engineers will welcome the opportunity to work with you. Write Dept. E3, READ STANDARD CORPORATION, 370 Lexington Ave., New York 17, N. Y.

Do you have the 1951 STANDARDAIRE Selection Chart?

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Begins on page 171

volving joints designed for steam or cold service generally in excess of 25-50 rpm to 2500 rpm in some models. 8-page catalog No. 300. Barco Mfg Co, 1801 W Winnemac Ave, Chicago 40, Ill.

B27 ROLLER CHAINS AND SPROCKETS—Provides complete specifications and engineering reference tables on American standard roller chains, sprockets and attachments. Dimensional data, strengths and weights are also supplied on allied products. Catalog No. RS-50. Whitney Chain Co, Hartford, Conn.

B28 MINIATURE SPEED CHANGES—Data sheet on Series 7 miniature speed changers for applications where the backlash between high and low speed shafts must be zero or very low value, and where input torque is available to overcome increased losses and roughness inherent with preloaded gearing. 2-page data sheet No. 7. Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.

METALS AND ALLOYS

B29 UNCOATED METALS — The ASME announces as available the proposed revision to American Standard preferred thicknesses for uncoated thin flat metals (under 0.250 In.) ASA B32.1. 6 pages. The American Society of Mechanical Engineers, Standards Dept, 29 W 39th St, New York 18, N. Y.

B30 TUBING STEELS—Technical information on tubing steels used in elevated temperature and high pressure applications. Included are data on carbon intermediate chrome molybdenum and stainless steels. 6-page bulletin No. 12F. Babcock & Wilcox Tube Co, Beaver Falls, Pa.

B31 TUBES AND PIPING—Handbook, "The Properties and Methods of Working Seamless and Welded Tubes and Pipe of the B&W Stainless Croloys," is designed to serve as a guide in choosing proper material and as a help in planning the conversion of stainless steel tubing into finished products for industry. 104-page bulletin No. 1B. Babcock & Wilcox Tube Co, Beaver Falls, Pa.

METERS AND INSTRUMENTS ELECTRIC

B32 ELECTRICAL RESISTANCE TESTERS—Describes the Midget Megger insulation tester, the CVM constant voltage type, and the Midget Megger circuit testing ohmmeter. Specifications and facsimile scales included. 8-page bulletin No. 21-85-24. James G Biddle Co, 1316 Arch St, Philadelphia, Pa.

B33 POTENTIOMETERS — Covers ElectroniK electric control potentiometers for both contact and proportional control. Includes application, engineering and construction data, types of control, partial list of available ranges, and accessories. 36-page catalog No. 15-15. Minneapolis-Honeywell Regulator Co, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

METERS AND INSTRUMENTS MECHANICAL

B34 SMOKE INDICATORS—Features the visual Wyd-Angle smoke periscope for marine and industrial use, and the Cat's-Eye furnace indicator for viewing furnace performance from any point in boiler room. 4-page bulletin No. 5101. Ess Specialty Corp, 96 S Washington Ave, Bergenfield, N. J.

B35 ELECTRIC TACHOMETER—Illustrates a new Reeves electric tachometer which operates on the ac generator principle. Installation and maintenance data, as well as dimensions and mounting charts included. Bulletin No. G-511. Reeves Pulley Co, Columbus, Ind.

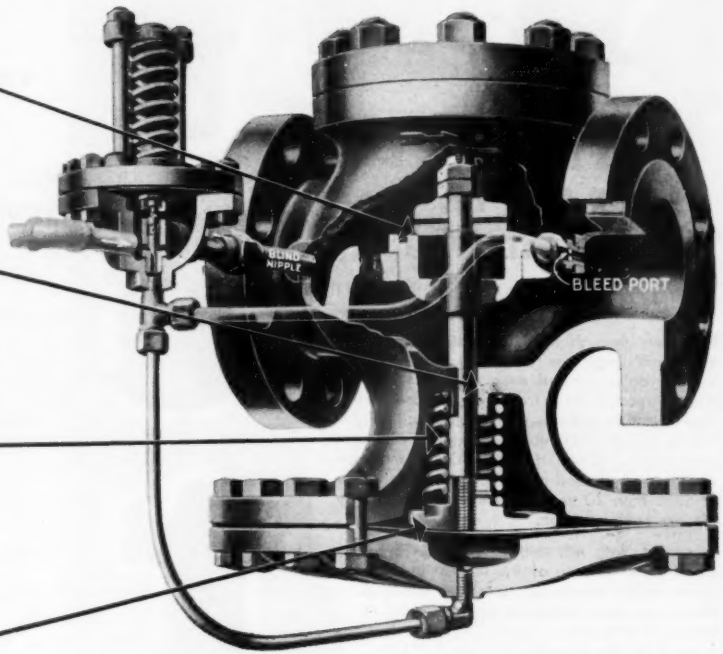
WHY Spence Regulators Outlast The Field

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than *twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.



Spence Type EQ back pressure regulator — operation of main valve is controlled by a sensitive pilot to regulate the initial pressure. Same pilot is used with all sizes of main valves.

The features shown above explain why you profit on every important count with Spence Pressure and Temperature Regulators.

Learn more about these and many other advantages of Spence Regulators by sending for Bulletin 350.

DURABILITY — Spence Regulators perform dependably year after year.

ACCURACY — You can be sure of accurate control for the life of the regulator.

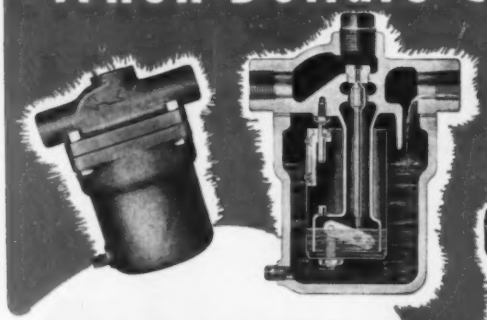
MAINTENANCE — You don't need expensive repairs or special maintenance. That means less down-time, less time and money wasted on replacement of parts.

SE-110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

When Dollars Count



"AIRXPEL"
STEAM TRAP
Proves Its Value

The only true test of steam trap VALUE is what the trap does AFTER it's installed.

Re-orders through the years are tangible proof that both engineers and maintenance men, as well as dollar-minded executives, like "AIRXPEL" traps—because these traps can be connected into the line and forgotten—whether the load is light or heavy, pulsating or non-pulsating, continuous or intermittent. STRAIGHT-THROUGH connections are an appreciated convenience, too. Instances of more than 20 years of uninterrupted service life are not uncommon.

Removing both AIR and CONDENSATE from steam lines in some of the largest industrial plants in the world—in vessels of the U. S. Navy and other maritime services—and in small low pressures systems, "AIRXPEL" has come to be the accepted standard of performance for open bucket steam traps. The principle of operation—its efficiency and economy, have been proven to the satisfaction of the most skeptical.

"AIRXPEL" steam traps in sizes up to 2 inches and pressures to 700 psig. Capacities to 34,500 pounds of water per hour. Complete specifications and application data in Catalog 600 help you select size and type best suited for your needs.

•63 "Master" Type
0-300 psig.

•71 Steel 0-300 psig.

•101 "Steel" Type
0-700 psig.

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B36 **ACCELEROMETERS** — Data and specifications on Glennite self-generating accelerometers, Models A403, A401 and A104. 4-page bulletin No. A403. Gulton Mfg Corp, Metuchen, N. J.

PIPING, FITTINGS, VALVES AND SPECIALTIES

B37 **VALVE ACTUATORS** — Data on valve actuators designed for the operation of gate valves, plug valves, dampers, diaphragm valves, butterfly valves and sluice gates. Details of construction, application and control are given. 4-page bulletin No. 512. Ledeen Mfg Co, 1602 S San Pedro St, Los Angeles 15, Calif.

B38 **EXPANSION JOINTS** — Gives sizes, dimensions, suggested applications and other technical data on a variety of joints from small flexible connectors for use on diesel exhaust lines to 30-ft dia self-equalizing joints for use in applications such as wind tunnels, etc. 4-page bulletin No. 351. Zallea Brothers, Taylor & Locust Sts, Wilmington 99, Del.

B39 **CORROSION - RESISTANT FITTINGS**—Includes a description of new corrosion-resistant fittings and shows how light-walled Schedule 5S corrosion-resistant piping reduces the cost of a typical piping layout. 8-page booklet. Horace T Potts Co, Erie & D St, Philadelphia 34, Pa.

B40 **VALVES AND FLANGES**—Sizes and dimensions are given on gate and needle valves, flanges, hose nipples, bars, welding electrodes and screw machine products. 6-page bulletin No. W-350-B5C. Worthington Pump & Machinery Corp, Harrison, N. J.

B41 **PIPING FABRICATION** — Illustrated booklet shows piping installations in steel mills, for gas transmission system, central power stations, water pumping stations, heating plants, oil refineries and chemical process plants. Engineering and fabrication facilities are included. 24-page bulletin No. 1700. Dravo Corp, Dravo Bldg, Pittsburgh 22, Pa.

B42 **PIPING POINTERS** — Manual covers fundamentals of sound piping practices and discusses various types of valve designs and how each should be used. Illustrates and names 80 kinds of fittings. A valve selection guide also included. 36-page manual. Crane Co, 836 S Michigan Ave, Chicago 5, Ill.

PRIME MOVERS AND ACCESSORIES

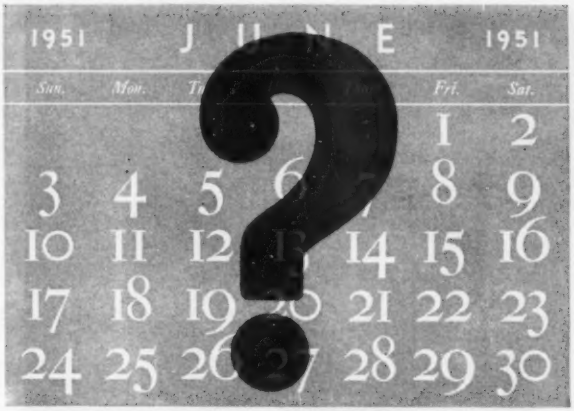
B43 **MULTI-STAGE TURBINES** — Covers Terry GAF and ZAF multi-stage turbines. The overspeed governor, governor valves, blades, diaphragms and other design features are discussed and illustrated. 6-page bulletin No. S-147. Terry Steam Turbine Co, Hartford 1, Conn.

B44 **STEAM TURBINE** — Technical data on a vertical drive steam turbine. Gives facts pertaining to its application to refineries, marine cargo, geared circulating and boiler feed pumps. 4-page bulletin No. VT351. Whiton Machine Co, New London, Conn.

WATER TREATMENT

B45 **SAMPLE INSTALLATIONS** — A discussion of boiler feedwater control in plants Yates, Atkinson and Arkwright of the Georgia Power Company. 16-page bulletin No. 489. Northern Equip Div, Continental Foundry & Machine Co, Erie, Pa.

B46 **WATER CONDITIONING** — Leaflet, "The Meaning, Application and Measurement of pH," shows different pH values of acids and alkalies, intensity of acidity or alkalinity, and most desirable pH range of industrial waters for different applications and conditions. 2-page leaflet No. 28X7636. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.



Will Boiler Tube Failure Sabotage Your Production This Month?

It can happen *any* day. Scale deposits may be forming in your boiler tubes *right now* . . . adding layer on layer . . . building up for the failure that is sure to come!

But whatever day failure occurs . . . you can be sure of one thing. It's going to be expensive! Often, many times more costly than *proper* corrective treatment.

Drew water treatment service *prevents* tube failures. First, a Drew engineer obtains complete operating and water data at your plant. Then these data are analyzed in the modern Drew Laboratories, and specific recommendations for corrective treatments are made. Finally, Drew engineers make frequent and continuous check-ups at your plant. This three-step procedure gives you the best results at the lowest cost.

Thoroughness of investigation and proper treatment have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew Boiler Water Treatment and Service. Do the same. Consult the nearest Drew engineer or write for information.

Send for the new, illustrated DREW ORGANICS Folder describing the use of organics in modern Boiler Water Treatment. Write today.

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DREW PRODUCTS

Rigid KENNEDY Inspection Guarantees Fittings Free of Leaks, Burrs and Scales

KENNEDY MALLEABLE-IRON screwed fittings are made with tough, close-grained iron, tested to 43,000 psi. Carefully controlled annealing prevents splitting or cracking under almost any distortion forces. Uniform hot-dip galvanizing assures a heavy coating that will not chip or flake. Precision machining provides exact alignment . . . speeds installation time.

KENNEDY CAST-IRON screwed and flanged fittings, are made with tough, close-grained metal *more than* 50% *stronger* than ordinary gray iron. Precision threading and accurately machined flanges help you get strong, tight joints easily. The complete Kennedy line also includes cast-iron sprinkler and drainage fittings, and cast-iron flanges.

KENNEDY BRONZE fittings with tensile strength of 34,000 psi are individually tested to 100 lbs. air pressure under water to insure freedom from leaks. Available rough or polished in all standard types and sizes.

WRITE FOR BULLETIN 104

Est. 1877

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VALVE MFG. CO. • ELMIRA, N.Y.

VALVES • PIPE FITTINGS • FIRE HYDRANTS

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B47 **ORGANIC CHEMICALS** — Describes the need for organics in altering the nature of sludge in order to make it non-adherent. Covers theoretical and practical considerations involved in the use of organics. 4-page folder. E F Drew & Co, Inc, Power Chemicals Div, 15 E 26th St, New York 10, N. Y.

OTHER EQUIPMENT

B48 **ALUMINUM GRATINGS**—Data on aluminum gratings for industrial flooring, stair treads, bridge decking, walkways and marine catwalks. 4-page bulletin No. 14-P-20. Irving Subway Grating Co, Inc, 5009 27th St, Long Island City 1, N. Y.

B49 **COMBUSTION SAFEGUARD**—Describes Protectoglo combustion safeguard for industrial gas- and oil-fired burners. Includes data on new flame-rectification principle of operation, installation drawings, price list, etc. 32-page catalog No. 9601. Minneapolis-Honeywell Regulator Co, Industrial Div, Wayne & Windrim Aves, Philadelphia 44, Pa.

B50 **TRUCKS AND HOISTS** — Gives description and applications of gas and electric fork lift trucks, motorized hand trucks, hand lift trucks, and hand and electric hoists. 44-page bulletin. Yale & Towne Mfg Co, Philadelphia Div, 1100 Roosevelt Blvd, Philadelphia 15, Pa.

B51 **CENTRIFUGAL PUMPS** — Discusses latest developments in the firm's line of single-stage, split-case centrifugal pumps furnished for direct connection to electric motors, steam turbines, gasoline engines, etc. 8-page bulletin No. 5004-A. Deming Co, Salem, Ohio.

B52 **SILVER-BRAZING ALLOYS** — Gives "do's" and "don'ts" of sound procedure in using All-State silver-brazing alloys. 4-page folder. All-State Welding Alloys Co, Inc, 273 Ferris Ave, White Plains, N. Y.

British Instrument Industry has scheduled its first exhibition devoted exclusively to instruments. It is planned for National Hall, Olympia, London, July 4-14, 1951.

Los Angeles Department of Water and Power is in excellent shape to supply all the city's water and electric demands for the next several years, according to Samuel B Morris, general manager and chief engineer. Last year, the department supplied 119 billion gallons of water to over 400,000 customers; 3½ billion kwhr of electricity to 670,000 homes, businesses and industries.

The world supply of new rubber in 1951 should reach nearly 2,800,000 long tons—by far the greatest in history—unless there is interference with production and shipment of crude from the Far East, according to **John L Collyer,** president of B F Goodrich Co. This tremendous supply of new rubber will be made up of 1,860,000 tons of crude rubber and 940,000 tons of man-made, with 880,000 tons of this produced in the U. S. A.

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Preventive Maintenance Helps To Attain High Production

Corrosion and fouling are two of the greatest offenders in petroleum refining. Corrosion shortens the life of the equipment while fouling builds up coatings of "gunk" and scale which reduce the heat-transfer rate and often accelerate corrosion.

The established practice of operating equipment beyond its rated capacity, in order to obtain maximum production levels, may have a very destructive effect on service life of equipment.

Importance of Keeping Heat Exchangers Clean

Recognizing that corrosion and fouling are major menaces to production and profit, most of the petroleum refineries keep staffs of trained people to carry on a program of periodic inspection and preventive maintenance.

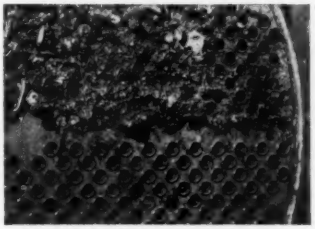
Careful records are kept of the performance and life of each piece of equipment, the nature and volume of the product; the cooling or heating medium; the composition of the tubes; the character of the corrosion and its effect on the life of the tubing. These records, built up over a period of years, indicate the expected tube life. Consequently, replacements can be made before failures actually occur.

Periodic inspections are made on each piece of equipment. The ones giving the greatest trouble are inspected more frequently. New equipment is thoroughly overhauled and inspected within a few months or at most within a year after it is put into operation to learn how it is standing up and to estimate its probable service life.

Corrosion Prevention from the Product Side

Refined petroleum products in themselves are not corrosive. Sour crudes, however, carry corrosive elements such as sulphur compounds, salts (mainly sodium and magnesium chlorides), and ammonia compounds. Salts are especially troublesome since they precipitate out and form a hard crust on the tube wall and are exceptionally corrosive to stainless steel. The establishment of a desalting process for treating all crude before it enters the equipment has reduced or eliminated this problem.

Where it is not practical to remove the sulphur, alloys and metals that resist sulphur corrosion are used. Arsenical Admiralty and arsenical Muntz are satisfactory when the concentration of other corrosive elements is not excessive. Sometimes Duplex Tubing with aluminum to the product side and arsenical Admiralty to the water side, may solve this problem.



Accumulation of trash on inlet ends of tubes in salt water cooled surface condenser.

For excessive ammonia, Duplex Tubing with steel to the product side and arsenical Admiralty or some other copper-base alloy to the water side, is recommended.

Fouling Accelerates Corrosion

The clogging of tubes and equipment with marine growth, which becomes especially troublesome in warm weather when circulating sea water is used, is retarded by chlorination. This is done periodically during each shift and varies with the season.

Severe storms which disturb the water and bring in silt and eel grass are surprisingly costly. Eventually the silt is removed by the force of cleaner water and by flushing, but eel grass, which may pass through the strainer plates and one or two passes of a large surface condenser, may mat on the tube sheet leading to the third or fourth pass and reduce circulation to a dangerously low level. Here only a complete shutdown and mechanical removal of the grass are called for.

The application of heat to most crudes causes the precipitation of carbonaceous compounds. These cling tenaciously to all metal surfaces and quickly build up heat insulating layers which reduce the heat transfer properties of the tube wall.

Overheating the tubes may lead to accelerated corrosion and, in cases where the circulating water is blocked off, the tubing may also be distorted by thermal stresses.

In order to determine the cleaning cycle, which is most economical, tests are made periodically to ascertain heat and capacity losses. This is plotted against the cost of cleaning and the downtime capacity loss. When the composite curve of these values begins to flatten out, the cleaning cycle is determined and scheduled.

Where the deposit is hard and cannot be easily removed by solvents or acids, the condenser or heat exchanger tube bundle is cleaned inside and outside by high pressure water containing an abrasive such as sharp sand. Certain types of deposits are very effectively removed by steam cleaning or by circulating inhibited acids or other solvents.

Research

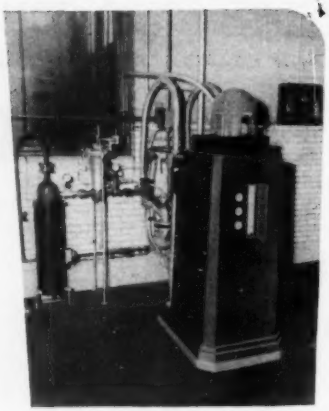
Constantly changing operating conditions increase the difficulty of fighting corrosion. Each batch of sour crude generally varies from the preceding one and requires special treatment. Circulating sea water, especially from harbors or at the mouths of rivers, tends to become more corrosive.

Operating engineers recognize that there is a difference in the behavior of various metals and often have one or more installations in trouble spots designed for experimental purposes.

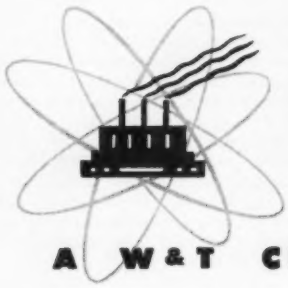
Instead of using tubes of one alloy, three or more different kinds of alloys are installed in the tube bundles, properly identified, so that individual ones can be pulled out from time to time for examination. Results obtained are helpful in determining which alloy should be used when retubing. (6709)

(Advertisement)

SAXTON'S SECRET WEAPON . . .



W&T Chlorinator Installation at Saxton Station



A W&T CHLORINATOR

In winning their battle against condenser slime at the Saxton Generating Station, Pennsylvania Electric Company, in their company publication, called the Wallace & Tiernan Chlorinator their "Secret Weapon."

Here's what happened before chlorine was tried. Experience showed even a small accumulation of slime caused a one inch loss in condenser vacuum — equivalent to a five to ten per cent reduction in plant efficiency. Frequent mechanical cleaning — expensive and disagreeable — still left a thin layer of slime. Cleaning compounds involving acids and alkalis were found an unsatisfactory answer to the problem.

Then Chlorine was tried! Preliminary tests indicated that coal consumption could be decreased by about $75 per day. *But,* feeding chlorine without special equipment proved both expensive and dangerous. A slight variation in feed rates resulted either in insufficient treatment or excessive chemical costs.

As a result of these tests, a Wallace & Tiernan Automatic Chlorinator was installed at Saxton in May 1949. This precision chlorinator made possible reduced coal consumption and virtual elimination of mechanical tube cleaning — the reasons why a W&T Chlorinator is Saxton's "Secret Weapon."

Hundreds of power plants have had benefits similar to those at the Saxton Station. Your W&T Engineer is prepared to help solve your slime problems — why not write for more information today — no obligation, of course.

CD-36

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

APPOINTMENTS

Babcock & Wilcox Tube Co, Beaver Falls, Pa., announces changes in top executive officers of the company as follows: Luke E Sawyer is elected president; Alfred Iddles, chairman of the board; Isaac Harter, consultant; and Edward A Livingstone, vice-president assigned to sales, takes on broader organizational responsibilities. James S Anderson assumes duties of chief of newly-created tubing section of Iron & Steel Div, Industries Operations Bureau of National Production Authority. Anderson's headquarters will be in the offices of the NPA, 5th & G Sts, NW, Washington, D. C.

C B Schmidt has been elected president of **De Laval Separator Co,** New York. George W Smith has been elected chairman of the board. George C Stoddard retires as president and director after 30 years of active association with the firm, but will continue to serve in an executive advisory capacity.

General Electric Co reports the following personnel appointments: W E Blowney is now divisions engineer of steam turbine, generator and gear engineering divisions at Lynn, Mass. L B Wales is made division engineer of auxiliary turbine engineering at Fitchburg, Mass. E W Cunningham becomes acting manager of industrial heating divisions, Schenectady, N. Y., assuming Carl L Ipsen's responsibilities. Ipsen is now associated with the NPA in an advisory capacity to the Machinery Div. L B Geson and O A Huntsman are named sales manager and assistant sales manager, respectively, of the metal-clad and switchboard section of Switchgear Divisions at Philadelphia. Louis H Matthes succeeds S Vernon Travis as sales manager for Large Motor and Generator Divisions. Travis is promoted to assistant general sales manager of Large Apparatus Div at Schenectady, N. Y.

J Cameron Argetsinger has resigned as vice-president of **Youngstown Sheet & Tube Co,** because of ill health. He will continue in a consulting capacity. John L Warner has succeeded E Kirk Harris, who retired recently, as superintendent of the company's South Chicago coke plant. Roy H Nelson has been transferred to Hubbard, Ohio, as assistant superintendent of the Hubbard Furnace.

Dearborn Chemical Co is now located in new quarters at Merchandise Mart Plaza, Chicago 54, Ill. Howard A Kreith is named purchasing agent.

Engineering, sales and service offices of **Bird-Archer Co** have been transferred from New York City to 4337 N American St, Philadelphia, Pa., where the company's plant is located. Executive and New York district sales offices will continue to be maintained at the Madison Ave address in New York.

Westinghouse Electric Co announces the following appointments: E W Ritter, manager of the firm's new electronic tube div, is named a vice-president. E V Huggins is

Back in the good old hickory-shaft days, many a golfer found sweet release in breaking up his clubs after a bad shot. Besides reducing his blood pressure to normal, this often saved the life of his hapless caddie. Now, in these days of steel shafts, the best way out is to make a date with the club professional.

For the best solution to your present piping problems, turn them over to professionals with more than fifty years' experience. Hundreds of installations in leading power and process plants are your guarantee of solid satisfaction.

We are independent piping fabricators and erectors.

W. K. MITCHELL & CO., INC.

2944 Ellsworth Street, PHILADELPHIA 46, PA.

Representatives in Boston, New York, Cleveland, Mobile and Havana

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MITCHELL

PIPING FABRICATORS AND CONTRACTORS SINCE 1899

• DIRECT HEATING OF VAPORS
• DIRECT HEATING OF LIQUIDS
If your plant requires
• DOWTHERM INDIRECT HEATING
• WASTE HEAT BOILERS
• STEAM SUPERHEATERS
• STEAM GENERATORS
. . . place the selection of the specific type in specialized hands . . . and obtain optimum efficiency.
Petro-Chem Development Company engineers are heating specialists . . . they can supply the whys and wherefores of indirect versus direct heating and the economics of both.
Every day more than 750, oil and gas fired, Petro-Chem Iso-Flow installations in the petroleum, chemical and allied industries, demonstrate the efficiency of their design and installation.
PETRO-CHEM DEVELOPMENT CO., INC.
120 East 41st Street, New York 17, N. Y.
Representatives:
Bethlehem Supply, Tulsa and Houston • Flagg, Brackett & Durgin, Boston • D. D. Foster, Pittsburgh Faville-Levally, Chicago • Lester Oberholz, Calif.

More APPOINTMENTS

Begins on page 236

elected executive vice-president of Westinghouse Electric International Co, foreign trade subsidiary of Westinghouse. William G Marshall is retiring as vice-president in charge of industrial relations. Robert C Twombly becomes manager of general-purpose turbine application-engineering section of Steam Div, Lester, Pa. In Small Motor Div, Lima, Ohio, H E Grout is named works manager; W P Bell, manager of manufacturing; and C F Herbold, superintendent of quality control. H E Plishker succeeds Russell E Ebersole as manager of lamp sales for Lamp Div, Bloomfield, N. J. Ebersole is now in charge of all commercial activities for Lamp Div.

Charles W Bloedorn has been named Southeast regional representative for **Allis-Chalmers'** steam turbine dept. His headquarters will be in Atlanta, Ga.

Elgin Softener Corp appoints Betz Engrg Sales Co, 1225 S Magazine St, New Orleans, La., as its sales representatives for Louisiana, southern Mississippi, northwestern Florida and southern Alabama.

Gerald D Dodd, assistant to president of **Foster Wheeler Corp,** assumes charge of manufacturing at the company's Carteret, N. J. and Dansville, N. Y. plants. He succeeds William Lonsdale who has retired from active duty.

De Laval Steam Turbine Co names T A Nilsen district manager of a new Texas district office recently opened in the Esperson Bldg, Houston. A N Sarich, for several years the De Laval Southwest technical representative in Oklahoma and Texas, will continue in the same capacity with headquarters in the new Houston office.

A A Wilson becomes manager of the Asheville, N. C. branch of **Graybar Electric Co.** He replaces H H Hix who will be on indefinite sick leave.

Graver Water Conditioning Co has chosen Flagg, Brackett & Durgin Inc, 405 Park Square Bldg, Boston, Mass., as its New England representative.

Hays Corp, Michigan City, Ind., promotes Jack J Tipton to position of chief project engineer.

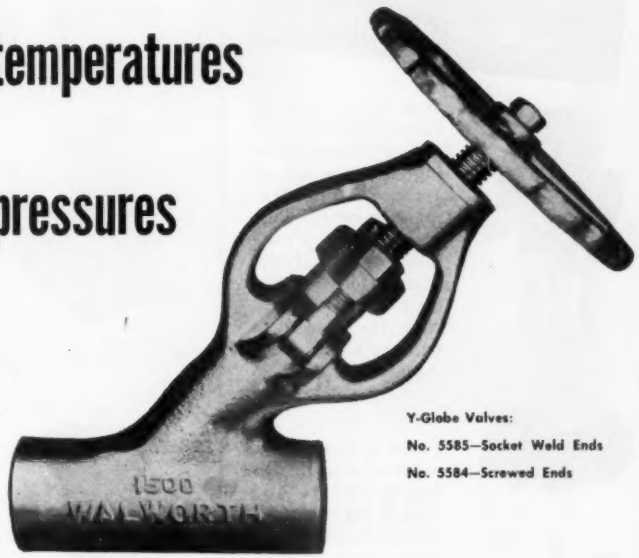
Standard Stoker Co, Inc, has changed its corporate name to **Read Standard Corp.** This is a change in name only. There has been no change in ownership, management or personnel. Operations under the new name are separated into 2 major divisions, namely: the Bakery-Chemical Div, heretofore designated as Read Machinery Div, and the Blower-Stoker Div.

John W May has been named to succeed William Deans as chief engineer of switchgear div of **I-T-E Circuit Breaker Co,** Philadelphia. Deans has been acting chief

Walworth's NEW small cast steel valves

SERIES 1500 – SIZES ¼ to 2 inches

handle HIGH temperatures
HIGH pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
No. 5587—
Socket Weld End
No. 5586—
Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

These Stickle Valves provide close-limit, chatter-free pressure regulation for liquid, air and steam

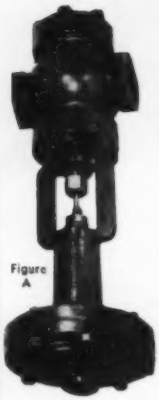


Figure A

Sensitive, accurate Stickle Valves will meet your most exacting requirements in automatic, positive pressure regulation... especially where pressures must be closely controlled within fractional variations. And they operate without vibrating or chattering, even when working close to seat.

Stickle Valves are available in two series — single-seated, balanced, Series 400 (Figure A) and double-seated, semi-balanced, Series 200 (Figure B). Series 400 Valves are spring- or lever weight-loaded, diaphragm-operated—built to regulate medium and high pressures and for dead-end service.

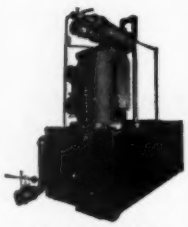
Figure B

Series 200 Valves are available in self-contained lever and weight types and pilot-operated construction. Also include Float Valves and Back Pressure Relief Valves. Once in service, they maintain pressures within variations of one-half of 1%.

All Stickle Valves have long service life—may be maintained easily right on the line. Get the full facts—*free*. Send for Stickle Bulletins 235 and 435—today.

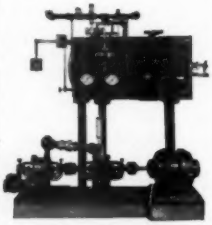
STICKLE STEAM SPECIALTIES COMPANY
2265 Valley Avenue, Indianapolis 18, Indiana

other cost-cutting STICKLE equipment



Stickle Open Coil Feed Water Heaters

Stickle Open Float Steam Traps



Stickle Differential Drainage and Boiler Return System

FREE! Get all the money - saving details, complete with illustrations. Write for free Stickle Bulletin Nos. 117 (Heaters), 115 (Traps) and 250 (Return Systems). Do it today!

More APPOINTMENTS

Begins on page 236

engineer since his recent elevation to vice-president in charge of engineering for all I-T-E divisions.

Infilco Inc, Tucson, Ariz., elects Lawrence K Cecil vice-president of the company.

C A de Vyver has been appointed manager of insulations of **Johns-Manville Corp,** N. Y. Duane D Crews has been made manager of construction, Industrial Products Div.

Globe Steel Tubes Co selects A B Murray Co, P O Box 476, Elizabeth, N. J., as its distributor.

Three abrasive engineers are transferred to new territories by **Norton Co** as follows: Sidney B Wetherhead is assigned to eastern Massachusetts territory to assist Raymond J Forkey. Charles A Babbitt takes over Maine, New Hampshire, and Vermont territory, operating under direction of Fred W Elya, northeastern district manager. Richard D Burdette succeeds Babbitt in the North Carolina and Virginia area, working under direction of Leroy K Behr, district manager.

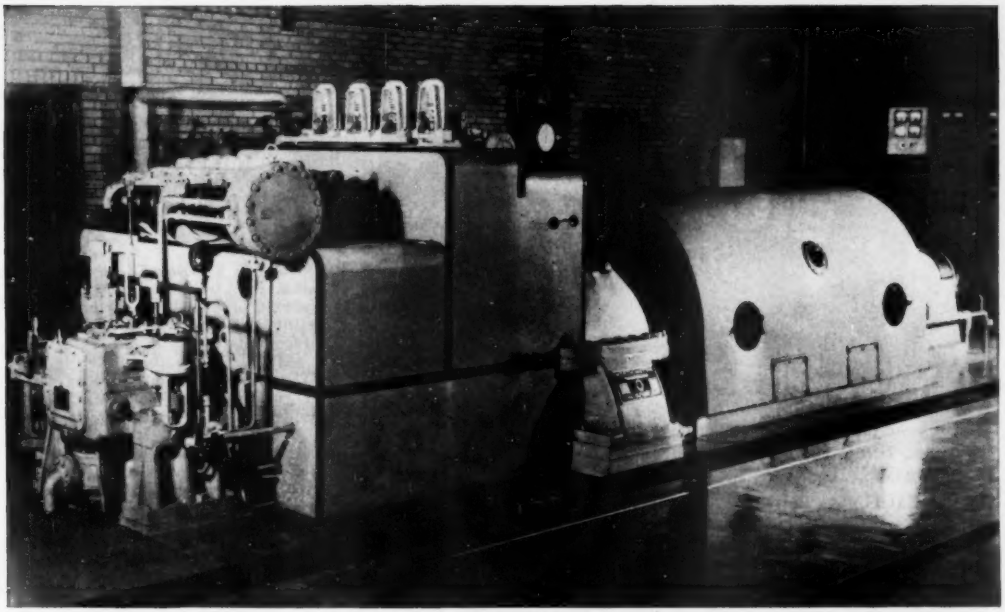
One of the nation' leading atomic scientists, Dr Charles Allen Thomas, has been elected president of **Monsanto Chemical Co,** St. Louis, Mo. He replaces William M Rand, who has retired under the company pension plan.

Proportioneers Inc has acquired Synchro-Master Co, formerly of Seneca Falls, N. Y., and will operate the business as its Synchro-Master Div with sales and production facilities located in Providence, R. I. Key personnel of Synchro-Master has also joined Proportioneers and will manage the new division.

Ralph W Rausch is made consulting engineer of **Link-Belt Co.** His headquarters will continue to be at the Pershing Road plant, Chicago. Joseph J Richard succeeds Rausch as chief engineer of this plant.

A F Reinking has been named manager of Steam Turbine Sales Div, **Worthington Pump & Machy Corp,** with headquarters at the Wellsville plant. Robert C Tierney will be in charge of the corporation's new vertical turbine pump plant at Succasunna, N. J., when it is completed.

Raybestos-Manhattan Inc announces election of George W Marshall Jr and Alvin F Heinsohn as vice-presidents. Marshall's headquarters are at the company's Manheim, Pa. plant, and Heinsohn's at the Asbestos & Rubber Div in North Charleston, S. C. Other elections include: W Ward Kievit, Passaic, N. J., assistant treasurer; William H White, Passaic, assistant secretary; and Charles J Geilfuss, North Charleston, assistant secretary. In addition, Kenneth A Tamms replaces Alex Watchorn, retired, as sales engineer for



Story of an Economy Drive

How the Worthington Steam Turbine Pays Dividends for the City of Litchfield

What happened at Litchfield, Minnesota, is a clue to a most economical power plant operation.

Originally, the Litchfield municipal power plant consisted of low-pressure boilers, a steam engine and a small turbine-generator unit. The exhaust steam is sold for municipal heating.

Next—a Diesel engine-driven generator was installed. The load grew, and finally, after a careful survey, it was decided to install a 3000-kw Worthington turbine generator and automatically extract steam for heating purposes.

Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000-kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

WORTHINGTON

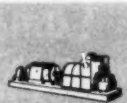
STEAM TURBINE GENERATORS

T.1.9

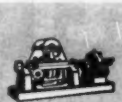
A GREAT TEAM IN STEAM

Single-Stage Turbines

Multi-Stage Turbines


Turbine-Generator Sets

Feed Water Heaters


Boiler Feed Pumps

Surface Condensers

Clean them the LAGONDA way—

...BIG TUBES ...small tubes
STRAIGHT TUBES
...or curved!

LAGONDA gives you the *right* cleaner for any tube cleaning job in your plant—all the way from ½ in. tubes up to 20 in. I.D. pipes. Utilize the 50 years of tube cleaning experience back of LAGONDA—the oldest name in tube cleaning. Write today for the LAGONDA Bulletin.

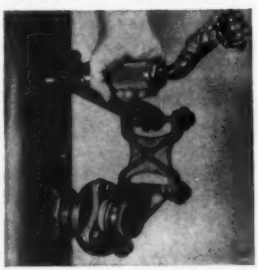
SUSPENSION CLEANERS
For small straight tubes. Motor remains outside of tube. Air, steam, or electric drive.

600 SERIES—For small tubes, straight or curved. For a fine cleaning job on tubes ½ to 1½ inches.

1300 SERIES—Air-driven cleaner for boiler tubes, straight or curved.

SURE CURE FOR LEAKY HANDHOLE SEATS!

When replacing handhole covers, prevent costly leaks by regrinding the seat with a LAGONDA Handhole Seat Grinder. Grinder clamps to header with a positive action that insures an accurate, single-plane motion of abrasive wheel. Steam cuts and pittings are easily and economically ground out. The cover mates with seat for an absolute leakproof fit. Write for the Handhole Seat Grinder Bulletin.



HALF CENTURY OF POWER PROGRESS 1901 1951

Y-305

ELLIOTT Company

LAGONDA DIVISION • SPRINGFIELD, OHIO

Plants at: Jeannette, Pa. • Ridgway, Pa. • Ampere, N. J.
Springfield, O. • Newark, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

More APPOINTMENTS

Begins on page 236

abrasive and diamond wheel dept's Wisconsin territory. Tamms will make his headquarters in Milwaukee. Charles Kuhn, oldest active employee of Manhattan Rubber Div, retires after 57 years' service as sales executive in the firm's New York sales office.

Schutte & Koerting Co announces consolidation of its general offices and manufacturing facilities in one location in an enlarged modern plant at Cornwells Heights, Bucks County, Pa.

Warren Steam Pump Co appoints Harry W Faunt Le Roy & Associates, Standard Oil Bldg, Baltimore, as its representatives.

Stanley F Krzeszewski has been elected a vice-president of **American Wheelabrator & Equip Corp,** Mishawaka, Ind. He will continue with his duties as factory manager.

Ampso Metal Inc transfers Louis C Begg to its newly established Buffalo sales div as district manager.

Dr Robert Lee Jickling has been named to post of chief chemist at **Bruner Corp,** Milwaukee, Wis. He will specialize in water conditioning and water treating problems.

Esterline-Angus announces appointment of Robert F Lamb to replace the late Dean Thomas as sales and service engineer in western New York.

Capt Thomas H Urdahl, USN (ret) is elected vice-president of **W B Connor Engrg Corp,** Danbury, Conn.

Greer Hydraulics Inc has chosen J M Grimstad Co as sales and service representative for the Minnesota and northwestern Wisconsin area. Robert Hazelrigg will be in charge, with headquarters at the Minneapolis office located at 2509 30th Ave S.

Fred H Angier is the new district manager for Philadelphia and Baltimore factory branch offices of **General Controls Co.** Territory includes the District of Columbia, Maryland, Virginia, West Virginia, eastern half of Pennsylvania, lower New Jersey and Delaware. He will be based in the Philadelphia office at 1238 Spring Garden St.

Laclede-Christy Co announces that it has purchased the plant and physical assets of Paterson Fire Brick Co at Clearfield, Pa.

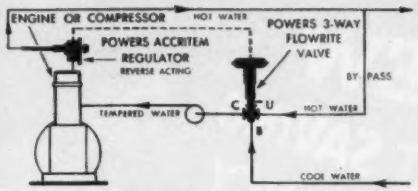
Morse G Dial is elected executive vice-president of **Union Carbide & Carbon Corp,** New York City. Dr George O Curme Jr becomes vice-president in charge of research.

Lighting sales dept of **Sylvania Electric Products Inc** has organized a new division

Before You Buy

JACKET WATER TEMPERATURE CONTROL

Investigate



One of Many Applications of
POWERS ACCRITEM REGULATOR and FLOWRITE DIAPHRAGM VALVE—
Compressed Air or Water Operated

—Provides positive, dependable control for large size 3-way or 2-way valves. ***Safety feature*** of hook-up above: failure of air or water pressure allows only cooling water to flow through the valve to engine.

POWERS

Complete Line of Dependable, Time-Tested Regulators

IMPORTANT ADVANTAGES that quickly pay back the cost of Powers self-operating and pneumatic controls for air compressors, diesel and gas engines:

- Correct jacket water and lube oil temperature at all times, regardless of load or seasonal changes.
- Improved lubrication and cylinder liner wear.
- Fewer piston ring replacements.
- Saves Labor; increases efficiency.
- Reduces danger of piston seizure.
- Eliminates sludging.
- Lowers fuel and lube oil consumption.

Cost of Powers jacket water temperature control? About the same as a set of new piston rings. Powers regulators are unsurpassed for reliability and years of trouble free service.

Have a POWERS Engineer call to study your requirements for better jacket water temperature control. There's no obligation. Phone or write our nearest office.

CHICAGO 14, ILLINOIS • 2771 Greenview Avenue
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TORONTO, ONTARIO • 195 Spadina Avenue
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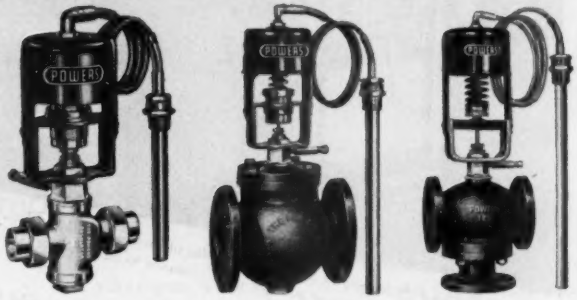
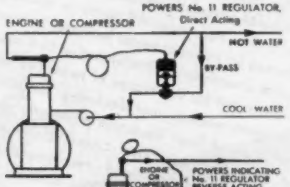
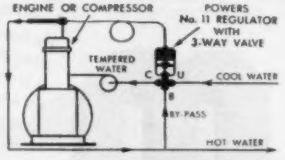
(DIG)

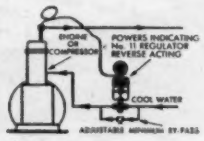
No. 11 Self-Operating TEMPERATURE REGULATORS

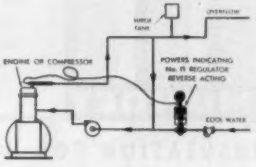


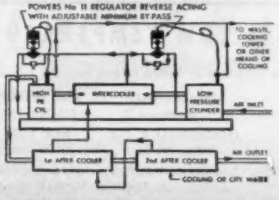
Provide dependable control for most applications. They're simple, ruggedly built, economical and easy to install. Especially suited for air compressors, diesel and gas engines. Temperature indicating regulator also available.

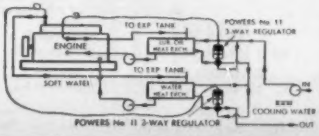












Established 1891 **THE POWERS REGULATOR CO.** OFFICES IN OVER 50 CITIES

Mundet 85% Magnesia Insulation provides attractive smooth finish . . . precise fit . . . maximum strength and resistance to vibration.

New heat saving efficiency is provided by Mundet Custom Molded 85% Magnesia Pipe Covering. Extra durability is built into this insulation. It is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7107 Tonnelle Avenue, North Bergen, New Jersey.

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INSULATION FOR HIGH & LOW TEMPERATURE

Mundet district offices are located in these cities:

ATLANTA
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BALTIMORE 30
612 Battery Ave.

BOSTON
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CHARLOTTE, N. C.
507 S. Cedar St.

CHICAGO 16
2601 Cottage Grove Ave.

CINCINNATI 2
427 West 4th St.

DALLAS 1
601 Second Ave.

DETROIT 21
14401 Prairie St.

HOUSTON 1
Commerce and Palmer Sts.

INDIANAPOLIS
15 E. Washington St.

JACKSONVILLE 6, FLA.
800 E. Bay St.

KANSAS CITY 7, MO.
1401 St. Louis Ave.

LOS ANGELES
(Maywood): 6116 Walker Ave.

In Canada:
Mundet Cork & Insulation, Ltd. 35 Booth Ave., Toronto

NEW ORLEANS 16
315-25 N. Front St.

NEW YORK 17
331 Madison Ave.

PHILADELPHIA 39
856 N. 48th St.

ST. LOUIS 9
3176 Brannon Ave.

SAN FRANCISCO 7
440 Brannon St.

More APPOINTMENTS

Begins on page 236

office and warehouse operation with headquarters in Dallas, Texas. Formerly this area had been serviced out of Kansas City. T J Ewbank has been appointed sales manager of the new division.

Whitney Chain Co, Hartford, Conn., announces election of James W Anderson as vice-president—sales, and C Robert Powers as vice-president—manufacturing.

L J Gorman, engineer in charge of electrolysis studies and corrosion control, **Consolidated Edison Co** of New York, has retired after 40 years' service.

L G Ireland, vice-president and chief engineer of **New Orleans Public Service Inc,** retires as of June 30 after nearly 27 years with the company and its predecessor.

Auguste Desilets, KC, of Grand'Mere, Quebec, is elected a director of **Shawinigan Water & Power Co.** He fills vacancy created by the recent death of Beaudry Leman.

Formation of a new jointly owned company to manufacture a unique air filter, first used by the Atomic Energy Commission to keep radioactive particles out of the atmosphere, is announced by **Arthur D Little Inc,** Cambridge, Mass., and **Carrier Corp,** Syracuse, N. Y. The new firm, known as Cambridge Corp, is headquartered at 350 S Geddes St, Syracuse, and initial production of the new filter is now under way. Raymond Stevens, vice-president of Little, is elected president, and David H Northrup of Carrier is vice-president and general manager of the new corporation.

Philip N Rugg of Boston Edison Co's industrial power sales dept, has been elected president of **Engineering Societies of New England,** 715 Tremont Temple Bldg, Boston.

T G Robinson is elected chairman of Gas, Fuels, and Combustion Section of **Western Society of Engineers.** Robinson is president of Meters & Controls Inc, representatives of Hays Corp in the Chicago area.

Cooling Tower Institute, Basking Ridge, N. J., has chosen W A Shoudy as executive manager. He is a well-known consulting engineer of New York City.

OBITUARIES

Elliott D Harrington, 54, recently appointed vice-chairman and secretary of the Defense Projects and Priorities Committee of General Electric's small and medium motor division, Schenectady, N. Y., died suddenly April 1 of a heart attack.

Frank L Orr, 56, vice-president and sales manager for Maxim Silencer Co, Hartford, Conn., died April 15 while on a business trip in Washington, D. C.

Good workmen + good tools + GOOD PIPE = GOOD JOB!

7 POINTS OF UNIFORM GOODNESS IN YOUNGSTOWN STEEL PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
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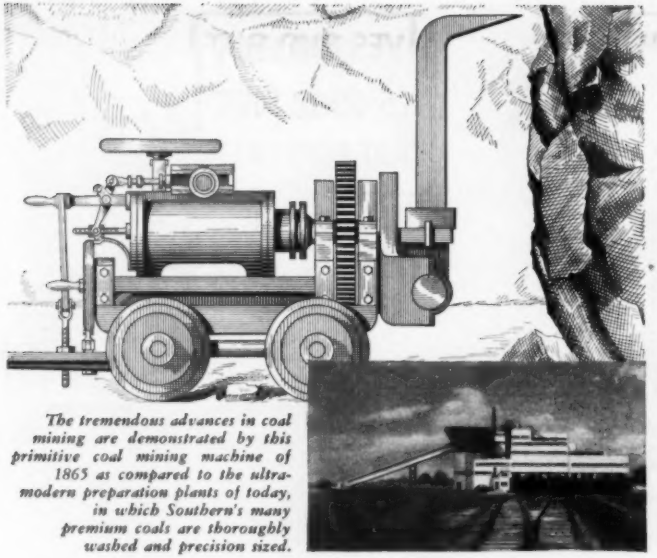

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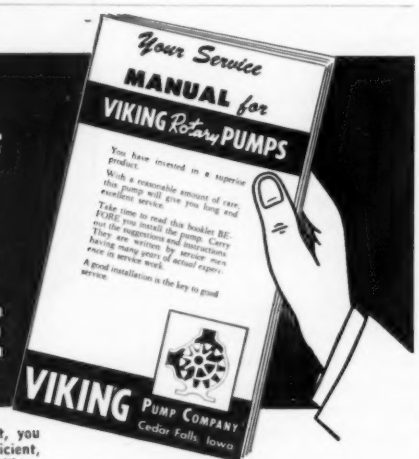
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Fig. 5

Standard vertical bronze water gage, 350 pound design, heavier construction up to 450 lbs. Stainless and forged steel for higher pressures.

Fig. 8

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Fig. 85S—Same fittings made in stainless steel.

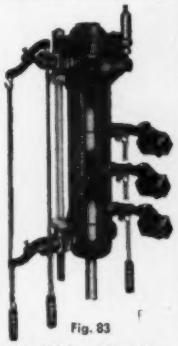

Fig. 83

No. 5 high and low alarm column with vertical gages and DCP weighted type try cocks.

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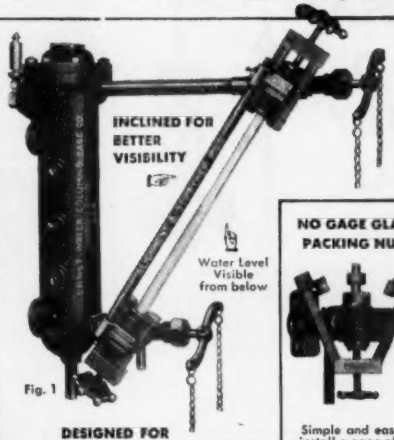

Fig. 1

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Fig. 45

Ernsthru Vision Mica-Protected Single Insert

Fig. 41 Illustrates Mica-protected insert with valves

Fig. 37

Prismatic Reflex Steam Shows WHITE; Water Shows BLACK

Fig. 10

Plain Sight Illuminator

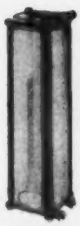

Fig. 31

Ernst Plastic Guard, Replaceable Plates

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Fig. 13

Ernst Leakless Try Cocks Assure Maximum Safety

Fig. 06

Bronze, with Wheel

Weighted Type Try Cock

Fig. 15

250 lb. Pressure, Bronze, with Iron Weight Double Chain Pull

Spring Type Fig. AS-250

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Fig. 17-28 Tubular Glass Type

Fig. E-811 Flapper Type Single Window

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Fig. 21—Lip Mold Rubber Gasket

Fig. 22—Standard Rubber Gasket

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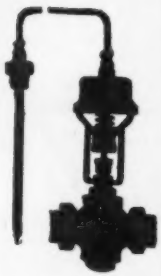

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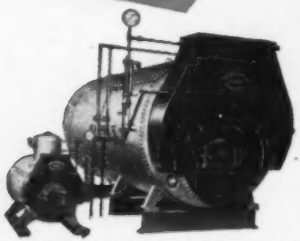

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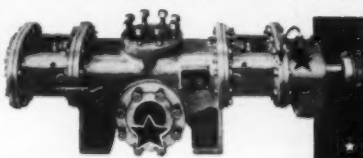

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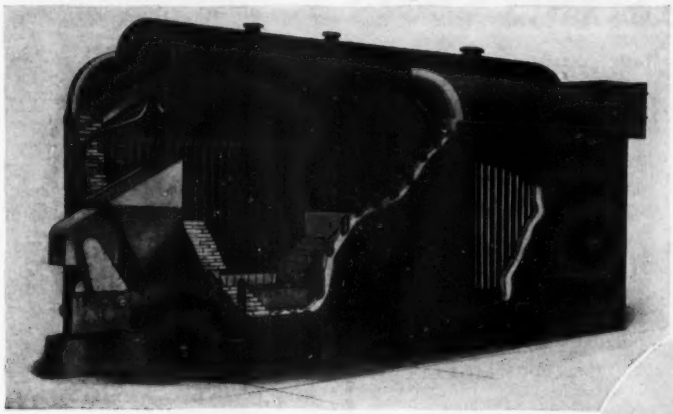
TYPE-VL *A Low Headroom*
2-DRUM WATER WALL BOILER



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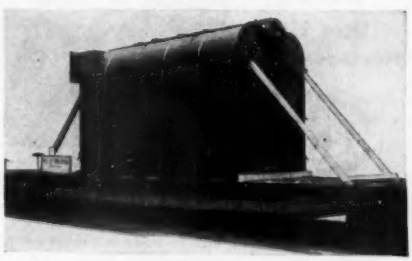

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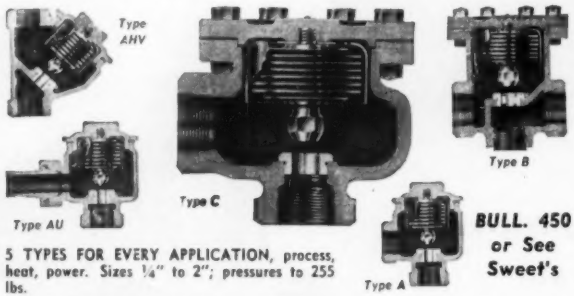

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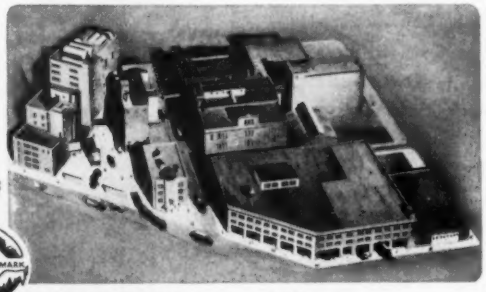

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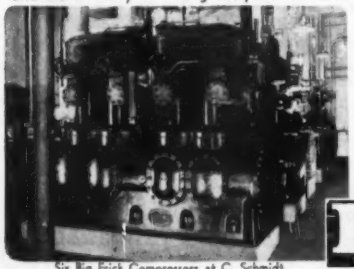

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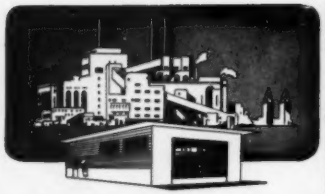

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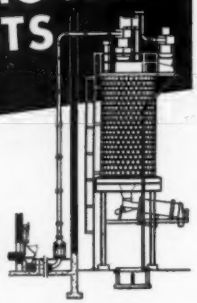

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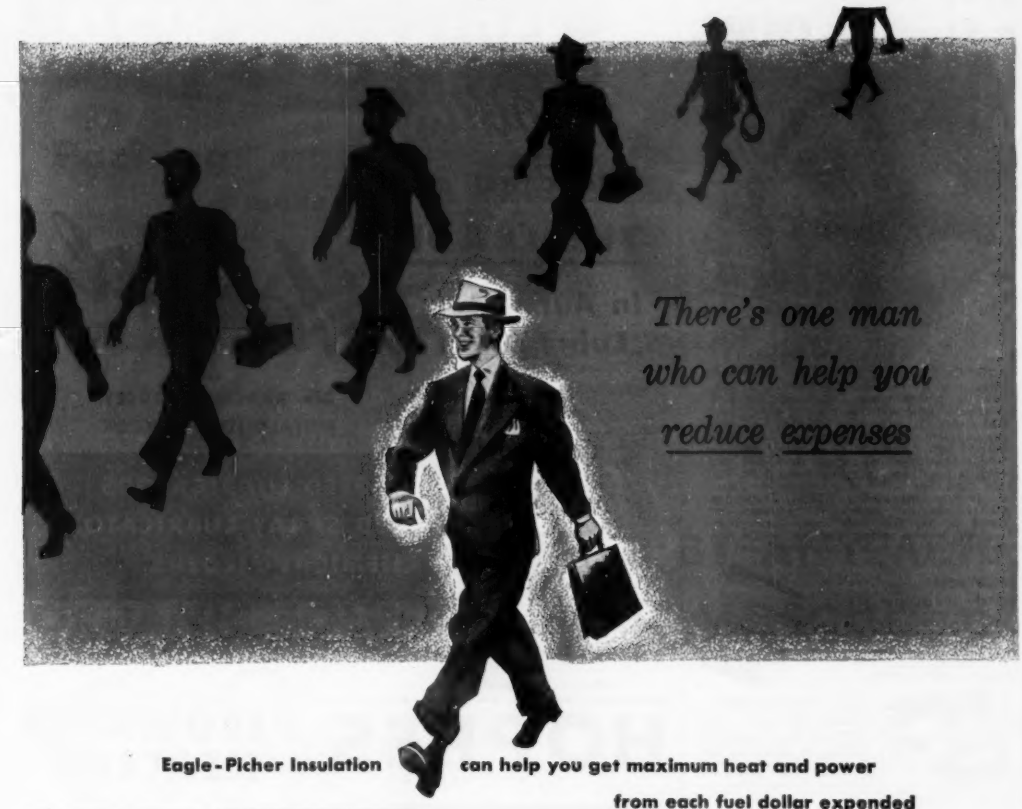

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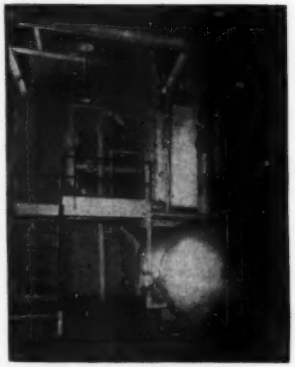

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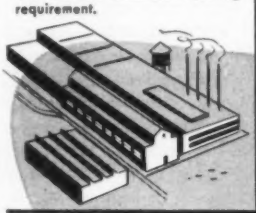

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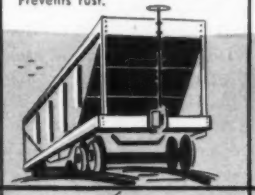

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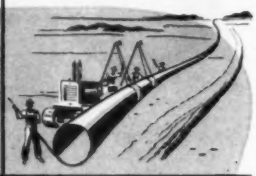

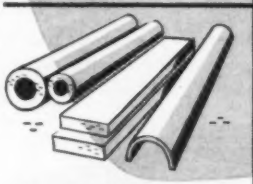

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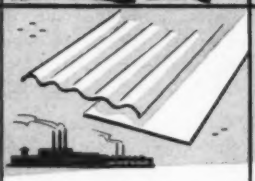

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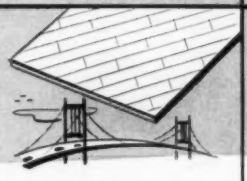

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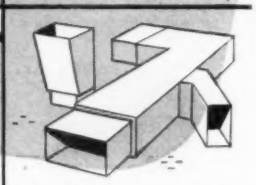

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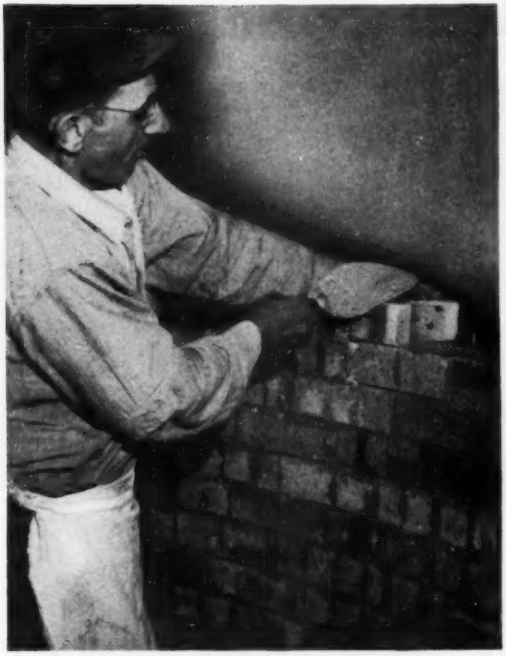
State **6/51/P**

How to Avoid *JOINT TROUBLE* In Furnaces or Kilns



Norton RA1019 Alundum* cement is recommended for laying up either silicon carbide or fused alumina bricks and blocks. It assures strong, thin refractory joints.

If your furnace or kiln walls weaken at the joints first, there are several possible causes. The cement may not be refractory enough and shrink excessively. It may be too coarse. The joint may be too thick.

What's the solution? Many users of refractory shapes have found that Norton RA1019 Alundum cement used in conjunction with Norton Crystolon* or Alundum brick make a combination that adds extra life to furnace and kiln walls.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

RA1019 ALUNDUM CEMENT

For most installations, users agree, you can't go wrong with Norton RA1019 Alundum cement for laying up either silicon carbide or fused alumina brick. This fine-grained, chemically stable cement, containing 80% fused alumina, matures at 1850°F and withstands temperatures up to 3100°F.

Here's how to use it. Dry-mix it before you add water to redistribute the bond and fines that may have settled out during shipment or storage. Then add enough water to make a slip just heavy enough to be troweled. Remember to stir it a bit every time you dip your trowel into it. Tap each brick into place . . . and you'll get thin, smooth joints that can really take it.

In cases, however, where a silicon carbide cement is mandatory — as in zinc and zinc oxide furnaces — Norton RC1130 Crystolon cement has proved eminently satisfactory.

CRYSTOLON BRICK

For lining forge furnaces and as piers and supports in oil- and gas-fired furnaces — where the use of fire clay is impracticable — Norton Crystolon refractory brick have piled up handsome performance records. It's not surprising. These silicon carbide brick are highly refractory (decompose at 4082° F) and highly resistant to thermal shock. They show no deformation under loads of 50 psi at 1500° C and no shrinkage at temperatures up to 2732° F. Their smooth surfaces lend themselves admirably to thin, smooth joints.

ALUNDUM BRICK

Where resistance to oxidation and basic slags is the determining factor in your choice of refractory, Norton Alundum brick are recommended over silicon carbide. Made of chemically stable fused alumina in percentages ranging from 92.0 to 99.5 depending on the grade, Norton Alundum brick are highly refractory, usable at temperatures up to 3350° F.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

Special REFRACTORIES

Canadian Representative

A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

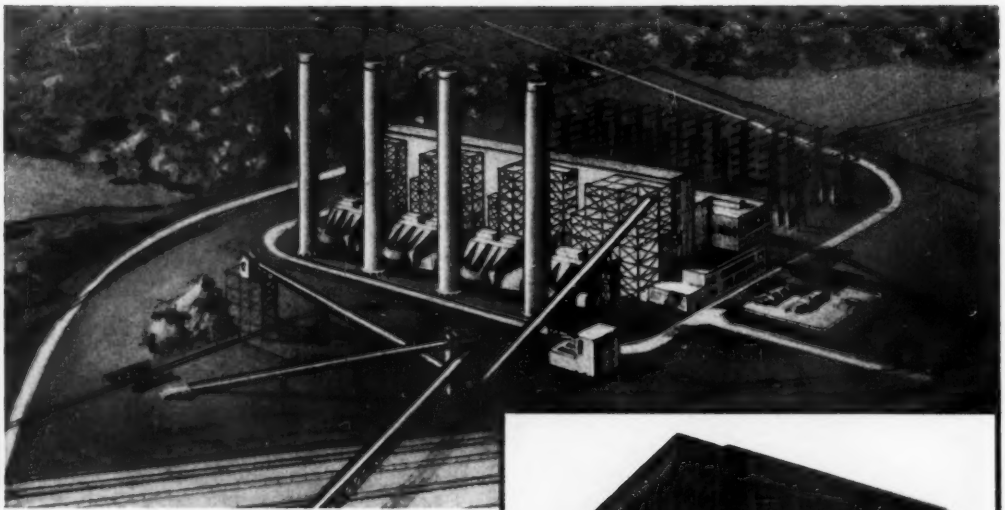
GET ALL THE FACTS

Two new Norton Bulletins — packed with factual data on refractory cement and brick selection — are yours for the asking. Contact your nearby Norton representative or write for Bulletins 863 and 862.

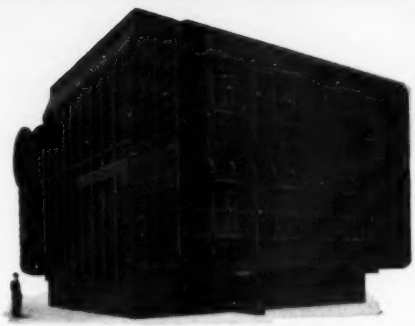
NORTON COMPANY
604 New Bond Street
Worcester 6, Mass.

New Meramec Station of Union Electric Co. to install two 90,000 sq ft

I-R RECTANGULAR CONDENSERS



Artist's sketch showing how Union Electric's new Meramec Station will look when all four sections are completed. First section is already under construction, with equipment for the second section on order.



This giant Rectangular Surface Condenser serves a 150,000 kw turbine generator in a Mid-Western central station. The compactness of the I-R rectangular design made it possible to fit the cube-shaped space available.

This new ultra-modern steam plant, located near St. Louis, Mo., is designed to include all the latest developments in power generation. The first section, which is now under construction, will cost $26,000,000.

The turbine-generator unit for the first section has a nameplate rating of 110,000 kw and is designed for 1250 psi steam at 950° F. It will be served by a two-pass Ingersoll-Rand Rectangular Condenser containing 90,000 sq ft of condensing surface. High pressure steam will be supplied by a boiler producing 925,000 lb per hour primary and 850,000 lb per hour re-heat. Another I-R Rectangular Condenser—identical to the first—has already been ordered for the second section of this new plant.

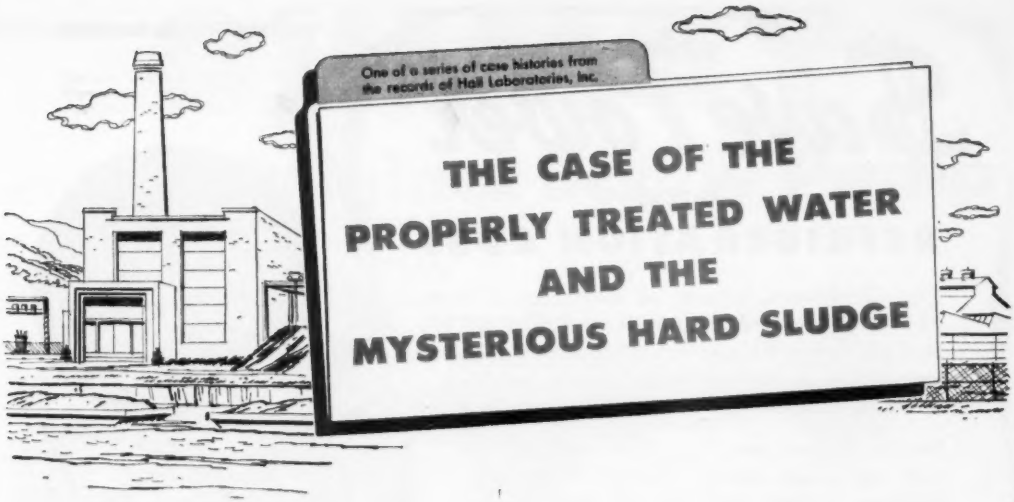
Compact I-R Condensers, such as these two, save valuable space and head room because their rectangular design fits the rectangular space available under the turbine. Installation expense is also greatly reduced because even these huge 90,000 sq ft units are completely assembled at the factory. Then they are disassembled and shipped in large sections which are flanged for easy erection without field-fitting or strength-welding.

Your Ingersoll-Rand engineer will be glad to give you complete information on these modern surface condensers and other I-R equipment.

Ingersoll-Rand

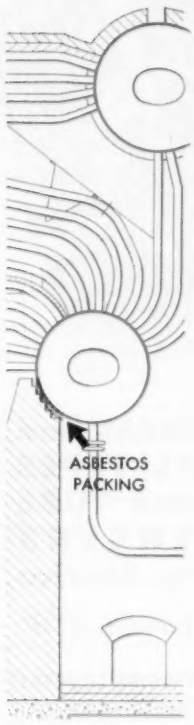
11 BROADWAY, NEW YORK 4, N. Y. 637-4

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES



One of a series of case histories from the records of Hall Laboratories, Inc.

THE CASE OF THE PROPERLY TREATED WATER AND THE MYSTERIOUS HARD SLUDGE



The 3-drum, low head 18,000 lb/hr boiler operated at 150 psi had presented no unusual problems in boiler water conditioning, and the routine check by the Hall Service Engineer showed that proper water conditions were being maintained. But—the same inspection also showed a layer of a dense, hard material in the mud drum, underneath the normal soft sludge. The Hall Engineer brought a sample of this unusual substance as well as samples of the soft sludge back to Hall Laboratories for analysis.

As expected, the soft sludge proved to be normal in composition, but the hard material was found to be composed mainly of soluble salts.

The Hall Engineer returned to the plant, and presented the laboratory report to the plant foreman, pointing out that the most probable cause of the condition was heat leakage against the mud drum and suggesting that the asbestos packing between the drum and the bridge wall must have fallen out. Together, they checked the installation, and found the condition which the Hall Engineer had predicted.

The Hall Engineer had realized from the appearance of the deposit that something was not functioning properly; Hall Laboratories supplied exact information on the nature of the deposit; and from this exact information, the imagination and experience of the Hall Engineer enabled him to predict the source of the trouble.

Let Hall Laboratories bring this same sort of teamwork to the study and solution of your specific problem. For more information, clip the coupon.

HALL LABORATORIES, INC.

(A SUBSIDIARY OF HAGAN CORPORATION)

CONSULTANTS ON BOILER WATER CONDITIONING;
PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.
Please send me your bulletin:
☐ Your Most Important Raw Material ☐ Let's Consider Your *Whole* Water Problem

Name_____

Position_____

Company_____

Street & Number_____

City_____ Zone_____ State_____

P-6

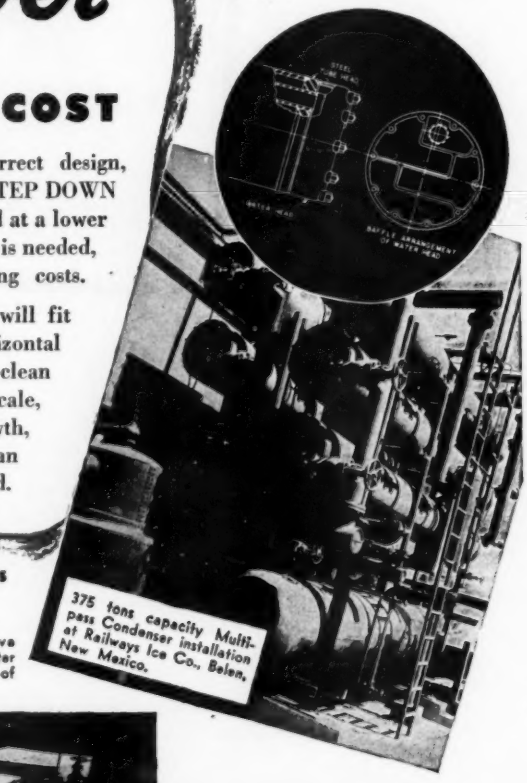
$ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

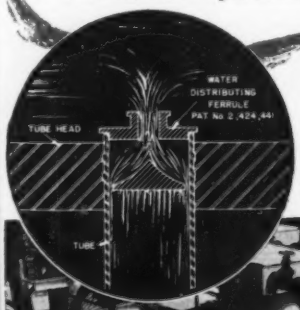
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

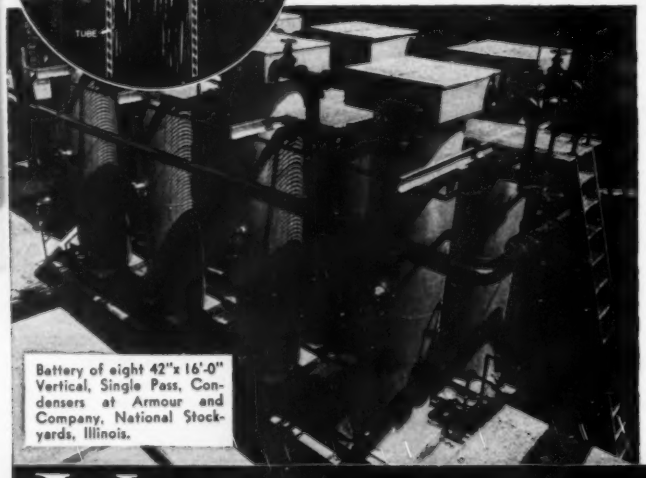


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

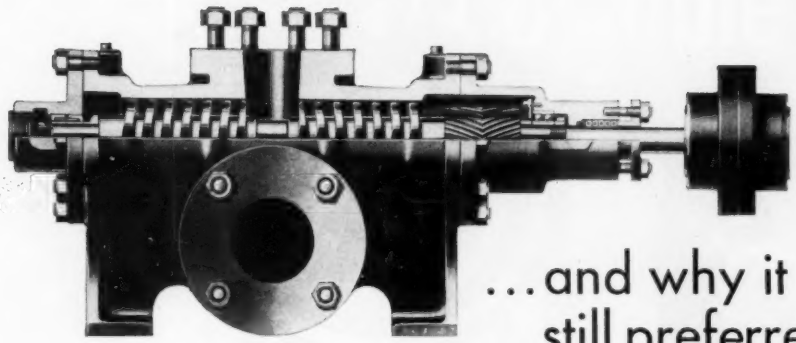
Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

QUIMBY

...the Original Screw Pump



...and why it is still preferred

100% Anti-friction bearing equipped. Due to their rolling action and minimum lubricating requirements, anti-friction bearings maintain their original clearances without appreciable wear. No hydraulic shock or discharge pressure loads on the bearings because Warren-Quimby Screw Pumps are 100% balanced axially.

Quadruple non-slip screws. A specially generated curvature is now used, producing a straight line contour between screws, essentially eliminating all slippage between these elements. Closer clearances without metallic contact insure higher efficiencies over longer periods.

Balanced power, pulseless discharge. No special foundations or bolting required for successful operation. Smooth running and quiet, with a minimum of churning or foaming of liquid handled.

No stuffing box troubles. In general, there are no packing troubles with Warren-Quimby Screw Pumps. By using sets of opposed intermeshing pumping screws, the flow of liquid is from each end toward the center, insuring suction pressure only on the stuffing boxes.

Herringbone Driving Gears. Smoother flow of power from the driving shaft to the idler shaft is accomplished by multi-tooth, precision cut, full herringbone gears. These gears are so positioned and timed as to maintain a definite clearance between the pumping screw elements.

Positioning Bearing. A fixed ball or roller bearing on the drive shaft effectively absorbs all external thrust loads. This permits full floating screw elements, free to expand at elevated temperatures without harm to the pump.

Interchangeability. All parts, excepting the body and length of screws and shafts, are interchangeable with corresponding sizes in the gear-in-head and external bearing designs.

The most complete line of Screw Pumps in the industry.

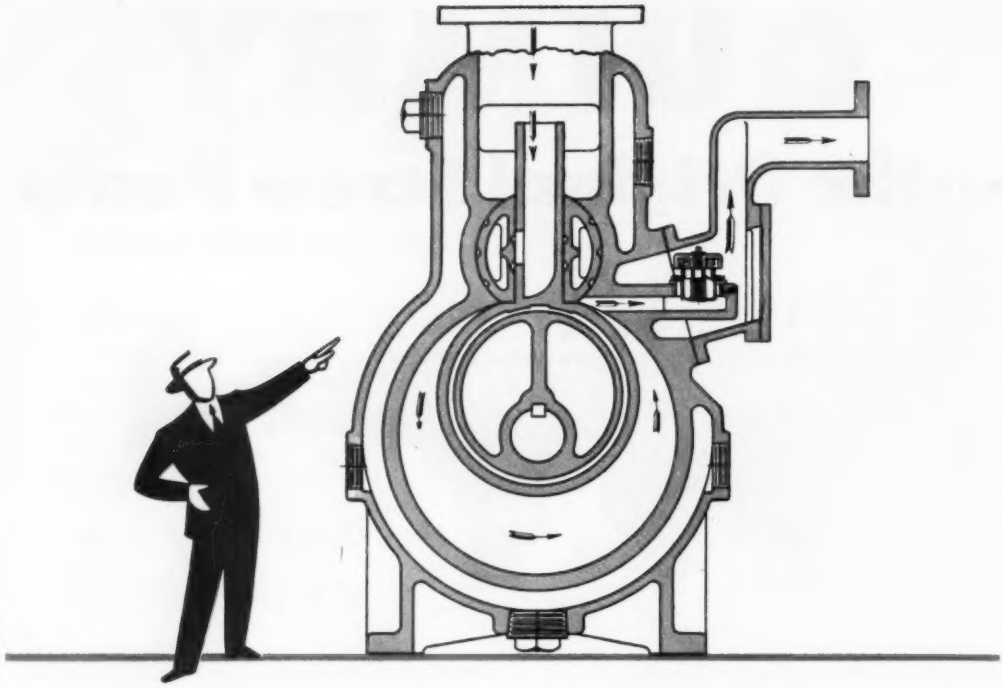
Insist upon the original...now owned, manufactured, marketed, serviced and guaranteed by Warren . . . one of America's pioneers of the pump industry. Write for bulletin S-204.

WARREN QUIMBY PUMPS

PQ-1

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS

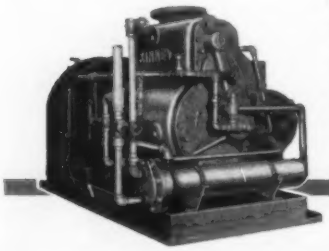


WHY YOU SHOULD INSTALL KINNEY VACUUM PUMPS FOR CONDENSER AIR REMOVAL

Kinney Mechanical Vacuum Pumps are demonstrating their advantages in many of the country's leading power plants. Anyone concerned today with the planning, designing, specifying, building, or operating of steam generating equipment must give serious consideration to Kinney Pumps for condenser air removal.

Here are the major advantages of these mechanical air pumps in high-temperature, high-pressure power plants:

- Kinney Pumps are controlled and operated from the main control panel, saving money, time, and legwork. Compare centralized control with the plant-wide surveillance required to operate steam jet ejectors.
- Kinney Pumps eliminate "hogging jets", pressure piping, and reducing valves . . . and their cost and upkeep.
- Kinney Pumps remove contaminating gases (ammonia, carbon dioxide, etc.), and eliminate the danger of corrosion due to heavy gas concentrations.
- Kinney Pumps perform the *complete* air removal job. They are equally useful in testing the condenser, in starting up after shutdown periods, and under normal operating conditions.
- Kinney Pumps are powerfully built to "stand the gaff" of continuous service.



Ask to see Kinney Pumps in operation . . . get the true performance story. We'll gladly send you the name of the installation nearest you. KINNEY MANUFACTURING COMPANY, 3532 Washington Street, Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Houston, New Orleans, Philadelphia, Los Angeles, San Francisco, Seattle and in foreign countries.

Send for our comprehensive report: "Mechanical Vacuum Pumps in Condenser Air Removal Service".

Kinney VACUUM PUMPS

HARBISON-WALKER

Plastic and Castable Refractories

LESS TIME OUT FOR FURNACE REPAIRS AND MAINTENANCE

MEANS MORE PRODUCTIVE HOURS

Because you can make furnace lining repairs effectively and quickly with Harbison-Walker CASTABLE and PLASTIC Refractories, "down" time losses are reduced to a minimum. Whether the job is one of normal planned maintenance or of emergency repairs, you will find in the complete line of Harbison-Walker Plastic and Refractory Castables, the type and class especially suited for your particular application. For various original constructions also, considerable savings in time, labor and cost are secured by the use of these monolithic materials in place of preformed brick and shapes.

H-W CASTABLES comprise all classes and fulfill the special needs for highest refractoriness and spalling resistance, strength, wear resistance and insulation.

H-W PLASTICS as shipped are ready-prepared to the proper consistency for use by ramming into place. They are available in STANDARD and SUPER grades and are furnished in slabs easy to handle and apply.

WRITE for bulletin describing these products. It gives data and information for estimating your requirements.

Harbison-Walker Refractories Company
AND SUBSIDIARIES

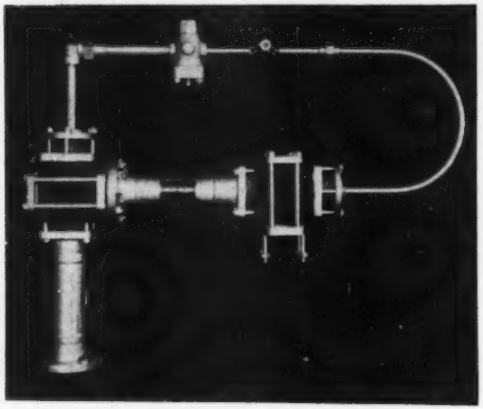
World's Largest Producer of Refractories

GENERAL OFFICES . . . . . PITTSBURGH 22, PENNA.

NOTES for the Power Engineer

C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM
PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY



Two-stage non-condensing impervious graphite ejector

Send for catalog 1462. It contains helpful tables and tips on Steam Jet Vacuum problems. It also describes the complete line of C. H. Wheeler Tubejets. It will be mailed at no obligation to you.

STEAM JET EJECTORS
Made of IMPERVIOUS GRAPHITE For Handling CORROSIVE VAPORS

If your vacuum equipment is inefficient due to corrosion from acid fumes, this item holds an answer to your problems.

For highly corrosive acids such as sulphuric, hydrochloric, nitric, etc. C. H. Wheeler impervious graphite ejectors are recommended. The impervious graphite is enclosed in a steel or cast iron casing to prevent breakage. It is light in weight, non-porous, with low coefficient of thermal expansion and high resistance to thermal shock. Impervious graphite is most commonly recommended for the single and two-stage non-condensing ejectors.

C. H. Wheeler Ejectors can also be furnished of other materials such as acid resisting bronze, monel and stainless steel where the corrosive action of the vapors being handled does not require the use of impervious graphite construction.

"SELF-CLEANING" CONDENSERS *by* REVERSE FLOW featured in C. H. WHEELER Bulletin

The C. H. Wheeler Manufacturing Company's unique design of an integral reverse-flow steam condenser provides the most practical method yet devised for cleaning the tube sheet, and eliminates the need for expensive mechanical water straining apparatus. A recently issued bulletin tells how it works.

For C. H. WHEELER Literature
Attach this Handy Form to Your Company Letterhead

Interested in following literature

- ☐ Steam Jet Ejectors (catalog 1462)
- ☐ "Self-Cleaning" Reverse-Flow Steam Condensers

Your Name .....

Your Job .....

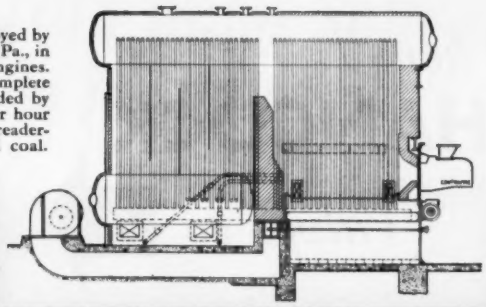
(Literature will be mailed to address shown on your company letterhead)

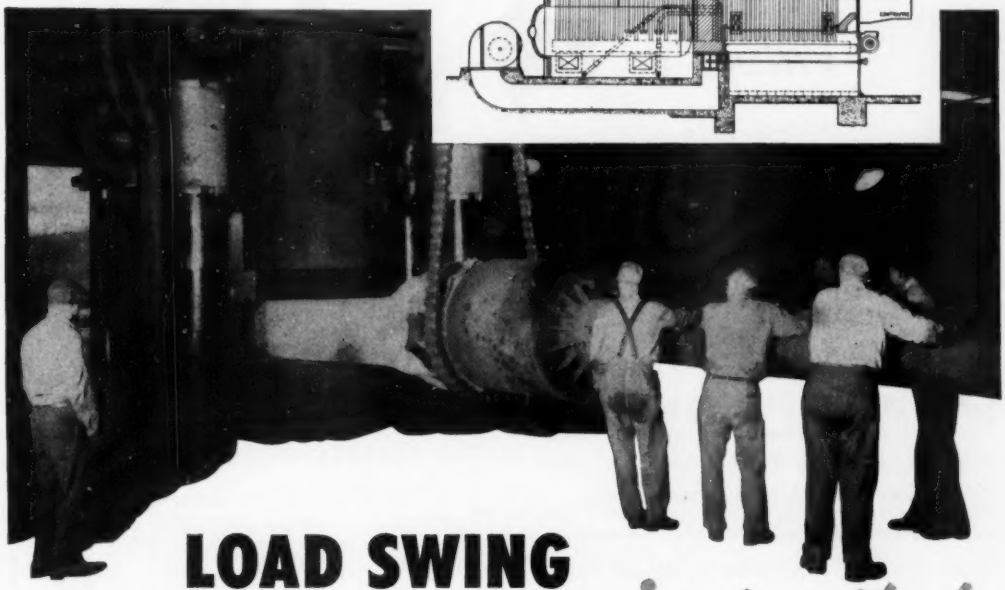
ANOTHER TOWER FOR SAN ANTONIO
13 Cell, 55,000 GPM Capacity to be Built by C. H. Wheeler for Gibbs & Hill, Engineers & Constructors

Following construction of two 7-cell Cooling Towers at the Leon Creek Power Station of San Antonio, Texas, C. H. Wheeler has been awarded the construction of a third and larger tower. The first towers were designed for 30,000 GPM. The new tower will handle 55,000 GPM to serve a 60,000 KW generator. It is a 13-cell induced-draft tower designed for 76.5° wet bulb, taking water at 105.5° inlet and cooling it to 90° outlet. Proposed construction is 39'8" x 364' x 29'. It will resist 30 lbs. per square inch wind pressure, or 100 mph hurricane force. Gibbs & Hill, New York are the engineers and constructors on the job.

C. H. WHEELER MANUFACTURING CO. 18TH AND LEHIGH AVE. PHILADELPHIA 32, PA.

This 2000-ton press is the larger of two employed by the Ellwood City Forge Company, Ellwood City, Pa., in shaping huge crankshafts for the largest diesel engines. Steam for these giant presses, as well as a complete forge-hammer shop, and plant services, is provided by a Keeler Type CP Boiler, 30,000 lbs. steam per hour maximum, fired by a Centrafire (Westinghouse Spreader-Type Stoker) with Link-Grate, burning local coal.





LOAD SWING
from zero to 30,000 lbs. *instantly!*

As the giant presses and forge hammers at Ellwood City Forge Company are turned on and off, load upon the boiler . . . and the stoker . . . swings *instantly* from 10,000 to 30,000 lbs. . . . and back again, just as suddenly. In summer the swing is from zero to 30,000 lbs!

That's a grueling test of flexibility and dependability in the stoker, which must provide an instant inrush of heat to maintain pressure on the upswing . . . and must cut off cleanly to prevent boiler popping on the downswing.

Prior to installation of a Westinghouse Centrafire® with Link-Grate, the hammermen were starved for steam . . . were handicapped and slowed down in working the metal; costly reheats were often required. Boiler popping lost expensive steam to the atmosphere.

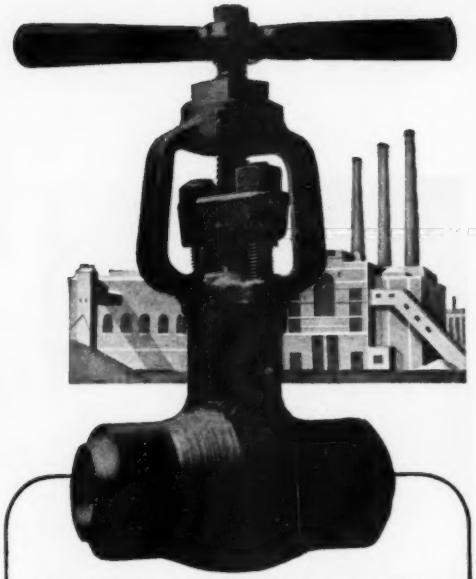
The Westinghouse Centrafire with Link-Grate, however, has ended these troubles. It follows the load . . . up or down . . . with a flexibility characteristic of the Centrafire. Moreover, with steam flow cut to zero for up to six hours between shift changes, the Centrafire holds the fire. And . . . there has been no forced shutdown of this unit since its installation.

You can have the flexibility...the reliability...the low operating and maintenance costs of a Westinghouse Stoker with any boiler of your choice. A Westinghouse Stoker Application Engineer is as near to you as your telephone . . . or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-50529

YOU CAN BE SURE... IF IT'S
Westinghouse
STOKERS

When HANCOCK *Valves go in*

Valve costs go down



HANCOCK 1500# and 2500# WELDVALVES are "top of the league" for sure, safe, and dependable service. These modern-design valves are the overwhelming choice of design and operating engineers of high-pressure steam plants.

And here are the major reasons: A functional design that positively eliminates leakage at the three spots where most ordinary valves will leak —bonnet joint, gaskets, and seat inserts, seat and disc life that is permanent, lighter valves that also save space yet will stand up in the most severe installations.

Two valve body sizes cover all pipe sizes up to and including 2 inches. Service rating up to 2500#–1050° F., W.S.P. and 6000#–100° F., O.W.G. Sizes from ¼ inch through 2 inches.

Install Hancock WELDVALVES once for the life of your boiler and lines!

HANCOCK 1500# & 2500# STEEL WELDVALVES

2 "Old Pros" on our winning team . . .

No team would be complete without a couple of "old pros" — dependable in action, solid as a line drive, sturdy as the player behind the plate. Hancock 1500# and 2500# Steel Weldvalves are the old "pros" of the Hancock Valve Line-Up.

In service in the majority of high pressure, high temperature power station installations! Here's why . . .

- Compensating yoke structure.
- Welded bonnet eliminating bonnet flanges and gaskets, means no bonnet leaks.
- Integral stellite seats.
- Major weight reduction to lessen piping strains.
- Can be serviced and maintained without removing from line.
- Size Simplicity. One size and design for ½", ¾", 1"; a second size covers 1¼", 1½", 2".

HANCOCK *Valves*

A PRODUCT OF

MANNING, MAXWELL & MOORE, INC.

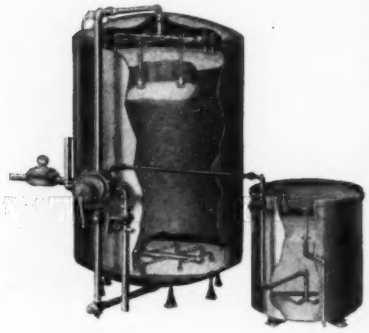
WATERTOWN 72, MASSACHUSETTS

Makers of 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties.

See What an ELGIN Water Softener can do for you

Prevents Boiler Scale Formation
Prevents Scale Deposits in Water Lines
ELGIN WATER SOFTENER
Prevents Scale Formation in Cooling Systems
Eliminates Costly Hard Water Troubles
Provides Soft Water for Processing
Keeps Water Heaters Clean

. . . One low cost investment . . . many profitable uses with the softener that gives up to 44% more soft water



How to make your water softener give up to 10 times more soft water

By simply replacing the low-capacity zeolite in your present water softener with new high-capacity Elgin Zeolite, you can increase its soft water output as much as 10 times. And if still more capacity is needed, you can get it by means of the Elgin "Double-Check" manifold arrangement which permits far more zealite to be placed in your water softener. Let us give you complete details.

NO OTHER water conditioning equipment serves so many useful purposes so *profitably* as the Elgin Zeolite Water Softener. It enables you to take full advantage of *all* the economies of softened water because its *extra* soft water output means *extra* dollar-saving uses.

In a given size softener this extra capacity can represent the difference between doing just *part* of a job and doing *all* of the job—the difference between providing just enough soft water for boilers and providing the extra soft water for preventing scale in water heaters, water lines, cooling systems, process work.

Yes, the records of thousands of installations prove that Elgin is today's most economical softener to buy and to operate. The reward of 43 years of intensive experience, it delivers up to 44% more soft water than other equipment of equal size using the same type of zeolite. A revolutionary "Double-Check" manifold arrangement makes this remarkable performance possible by permitting a deeper zeolite bed to be used more effectively without zeolite loss.

Elgin's "Double-Check" manifold arrangement and new high capacity zeolites can be used in existing water softeners of any make to greatly increase soft water output and give better-than-new performance. Whether you need a new water softener, or whether your present one needs rejuvenation, it will pay you to find out how much Elgin has to offer you.

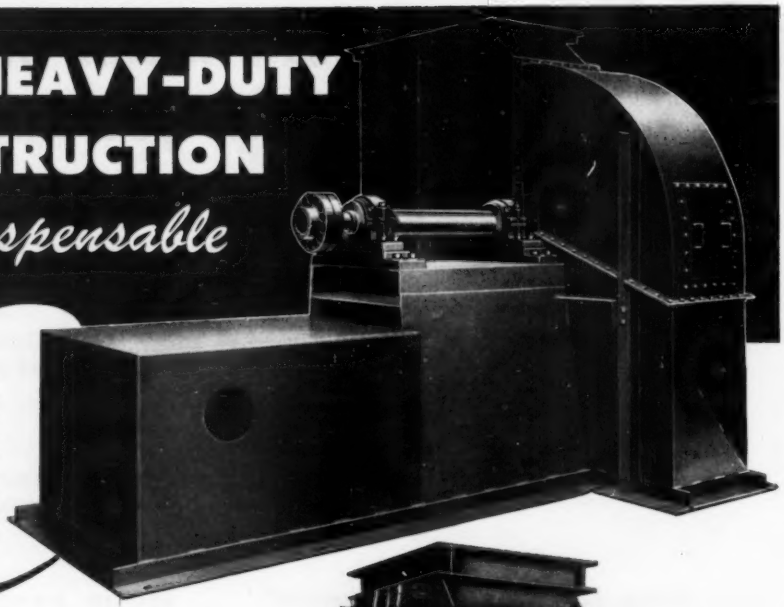
Ask for Bulletin 610 or let us have our nearest representative call.

ELGIN SOFTENER CORPORATION
130 North Grove Ave., Elgin, Ill.
Representatives in Principal Cities

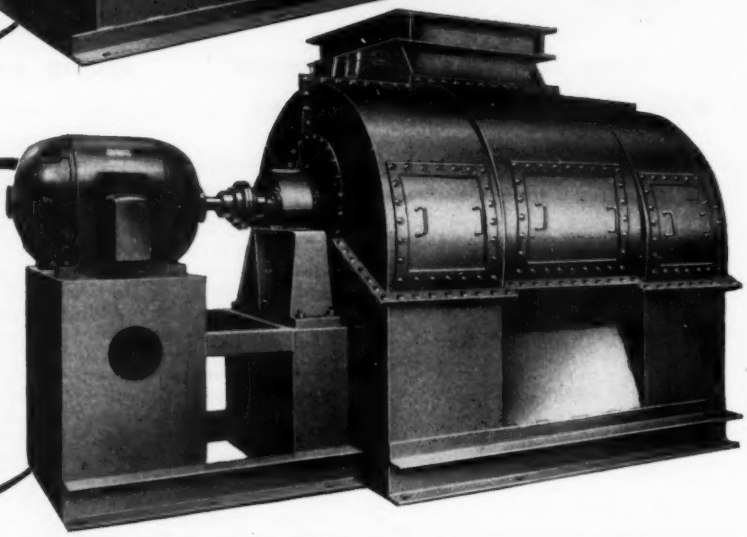
ELGIN
Economical
WATER CONDITIONING
FOR EVERY NEED
SINCE 1908

OTHER PRODUCTS: Delonizers • DeAlkalizers • Filters • Degasitors • Corrosion Control Systems • Water Treating Chemicals • Water Testing Equipment

Now HEAVY-DUTY CONSTRUCTION *is Indispensable*



HEAVY-DUTY single width fan for handling large volumes of air at high pressures—either supply or exhaust applications. Speeds suitable for motor or turbine drive.



HEAVY-DUTY double width fan for handling large volumes of air at medium high temperatures. Fan cooled bearings (Clarage development) insures satisfactory operation despite heat.

YOU CAN'T TOLERATE PROCESS AIR FAILURES IN DEFENSE PRODUCTION

Durability plus! . . . fan equipment to master the toughest assignments . . . fans to meet any size, any type of air handling need! **Clarage HEAVY-DUTY equipment** is built above and beyond the demands of average service. It is the make of equipment so many engineers in industry prefer for their **most important fan jobs.** We welcome your inquiry for any desired data.

CLARAGE

—HEADQUARTERS for Air Handling and Conditioning Equipment

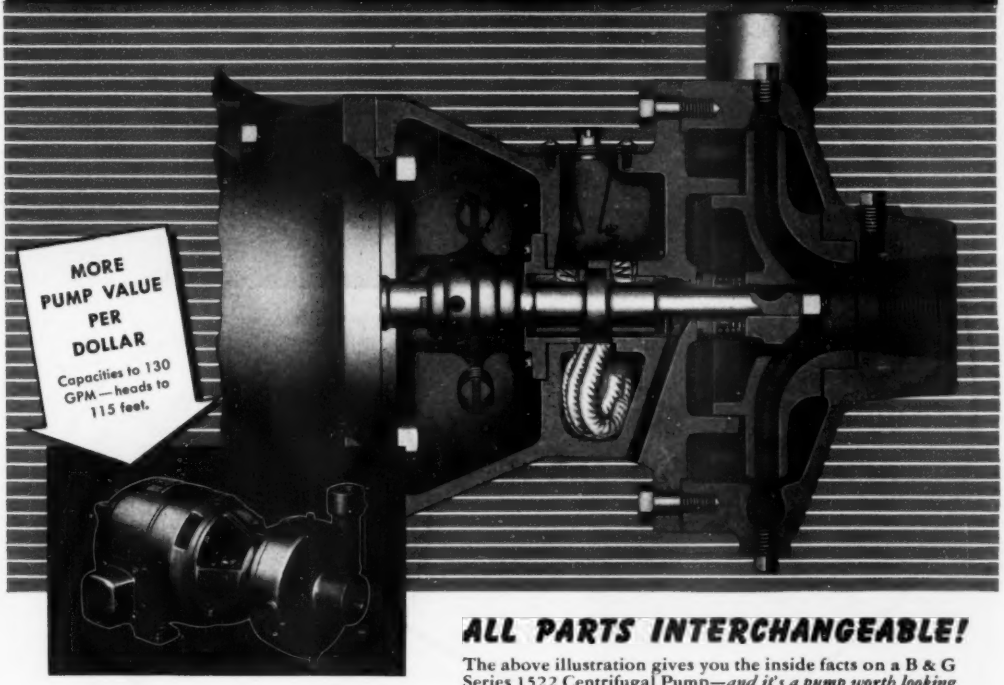
CLARAGE FAN COMPANY

KALAMAZOO, MICHIGAN

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

B & G 1522 *Challenges Comparison*

...WHERE ELSE CAN YOU FIND SO MANY PERFORMANCE FEATURES IN ONE PUMP!



B & G Type "SU" Instantaneous Water Heaters

For heating water with steam. Ideal for industrial plants where large volumes of hot water are required continuously for service water supply or process work. No storage tank required—the large heat transfer surface in these units heats water instantly as needed. Available in wide range of capacities.

ALL PARTS INTERCHANGEABLE!

The above illustration gives you the inside facts on a B & G Series 1522 Centrifugal Pump—*and it's a pump worth looking into!*

Viewing from left to right, note the *exclusive* spring-type Coupler—keeps noise at a minimum. Next, the Shaft—polished special alloy steel of finest quality, with electronically hardened thrust collar. It rotates in long Bronze Bearings which assure alignment and smooth operation. Oil from the reservoir is brought to the bearings by the wicking—keeps them thoroughly lubricated.

Now the Mechanical Seal—self lubricating—positively excludes water—ends annoying leakage. And finally, the Impeller—hydraulically balanced and highly efficient throughout the entire capacity range.

All parts are interchangeable in B&G Series 1522 Pumps. By removing a few bolts, the pump separates into three parts—very easy to service if ever necessary.

The B & G 1522 is really a pump you can lean on! For complete information, send for Catalog CY-350.

*Hydro-Flo** PRODUCTS

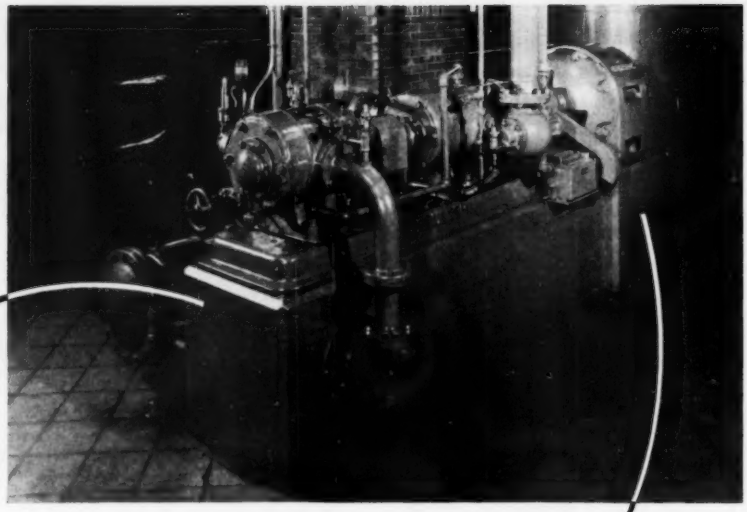
Heat Exchangers . . . Water Heaters . . . Pumps . . .
Refrigeration Equipment . . . Forced Hot Water Heating Systems

BELL & GOSSETT COMPANY

Dept. CY-36, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Road, Toronto, Canada

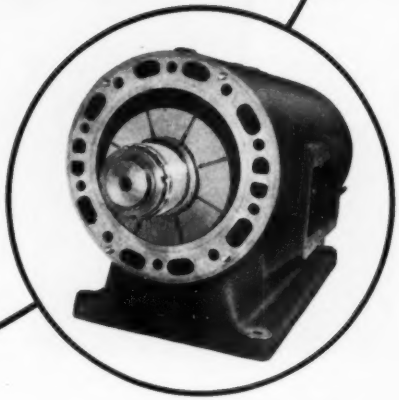
*Reg. U. S. Pat. Off.



Two-stage rotary compressor installed in a public utility electric generating station. Capacity 477 c.f.m., 100-lb. pressure.

JOHNNY ON THE SPOT . . . AND ALWAYS ON THE JOB

PRESSURES TO 125 psi.
CAPACITIES TO 3300 cfm.



Fuller Rotary Compressors are about the most faithful workers you can put on your payroll. You can spot them where you need them . . . and always be sure they'll be on the job day after day, week after week.

Fuller Rotaries are built to be dependable and economical in operation. They have but few moving parts . . . the rotor, bearings, and blades. That means infrequent inspection, and minimum maintenance. Because blades automatically compensate for wear, full capacity is maintained for the life of the machine. Every detail in Fuller Compressors is engineered for one purpose . . . to give a lifetime of new machine efficiency.

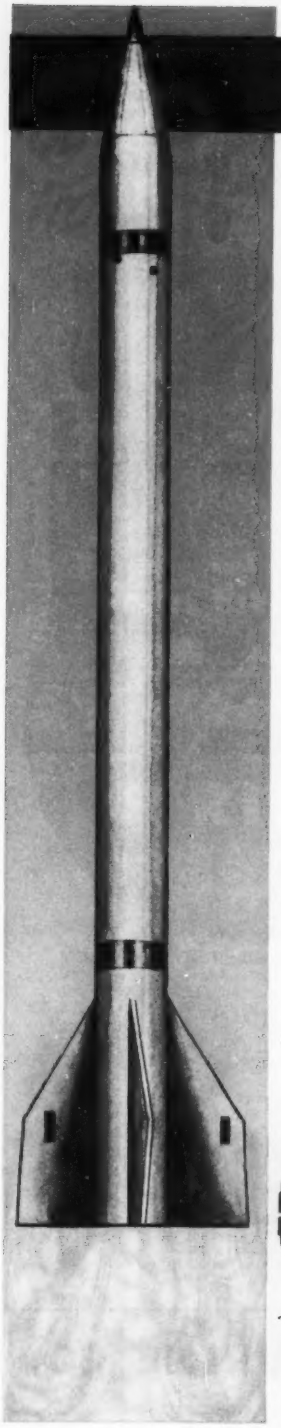
Fuller engineers will be glad to work with you for the proper application of Fuller Compressors to your particular requirements. You'll be taking a long step toward more economical, efficient operation if you call them in today . . . or write for Bulletin C-5, describing and illustrating these machines in detail.

FULLER COMPANY Catasauqua, Pa. | 120 S. LaSalle St. Chicago 3 | 420 Chancery Bldg. San Francisco 4

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS— COMPRESSORS AND VACUUM PUMPS— FEEDERS AND ASSOCIATED EQUIPMENT

fuller

C-204



MODERN FISHER® Improved LEVEL-TROL®

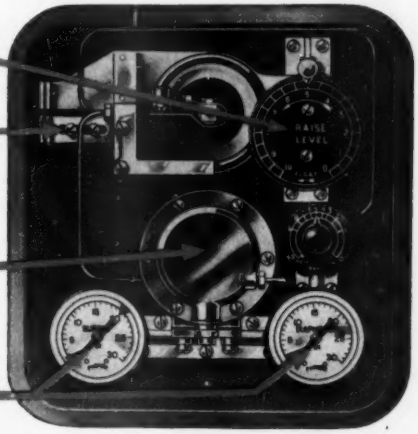
FOR LIQUID LEVEL CONTROL TRANSMISSION and INDICATION

Improved Feature
New level set adjustment. More highly visible.

Improved Feature
New factory calibrating adjustment makes possible accurate setting of proportional range over full float length.

Improved Feature
New relay—more compact—easily removed—easily assembled.

Improved Feature
Operating medium and diaphragm pressure gauges are glass-enclosed.



Type 2500-249
Level-Trol

• This improved Fisher Series 2500 Level-Trol is designed to better meet the requirements of field service—to give longer life—ease of maintenance. It still combines proportional range and specific gravity setting in one simple adjustment. Die cast weather—proof pilot case with black enamel finish, and improved lock hasp. Series 2500 Pilot Assembly is interchangeable with Fisher Series 2405 Pilot Assemblies now in service.

FISHER GOVERNOR CO.

MARSHALLTOWN, IOWA

FOR LOW-COST MAINTENANCE with the greatest of ease!

See how Darling cast steel gate valves save you time and money!

YOU know how important low-cost, *easy* maintenance can be. It's one of many Darling Valve features worth shouting about.

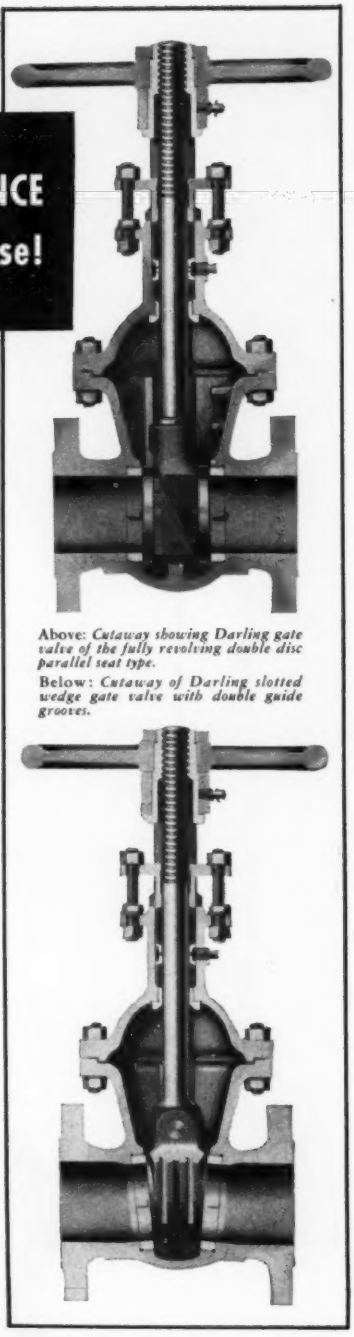
For example, all *Darling* parts are precision-made to jigs and templates. Replacement parts slip in quickly and easily.

What's more, Darling valves are designed so that seat rings and all working parts are easily removed and replaced without taking the valve bodies from the line.

These maintenance and repair advantages, plus many other time-and-money-saving features, apply to Darling gate valves of both popular types shown at right. It adds up to low-cost performance at its over-all *best!* Ask for the Darling Cast Steel Valve Bulletin. Get *all* the facts so you can judge for yourself!

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

FOR EVERY NEED. *Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.*



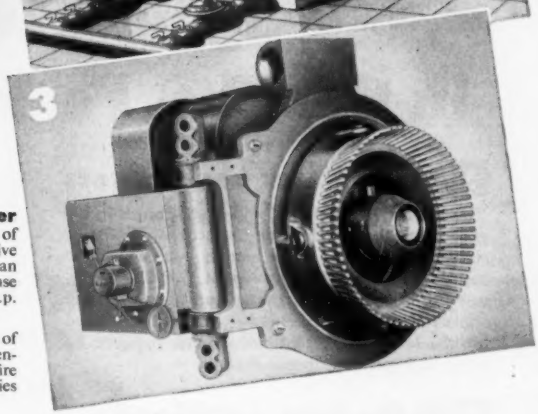
Above: *Cutaway showing Darling gate valve of the fully revolving double disc parallel seat type.*

Below: *Cutaway of Darling slotted wedge gate valve with double guide grooves.*

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Can you afford to waste what Iron Fireman users are saving?



Install Iron Fireman GAS FIRING

for power, processing or heating

1. Iron Fireman Radiant "Inshot" Gas Burner
This low pressure burner has an efficient firing range of 10% to 100% of capacity, making it a particularly effective burner for modulated firing. Opposed gas jets and an improved method of air entrainment produce an intense radiant flame. Capacities range from 6 to 500 boiler h.p.

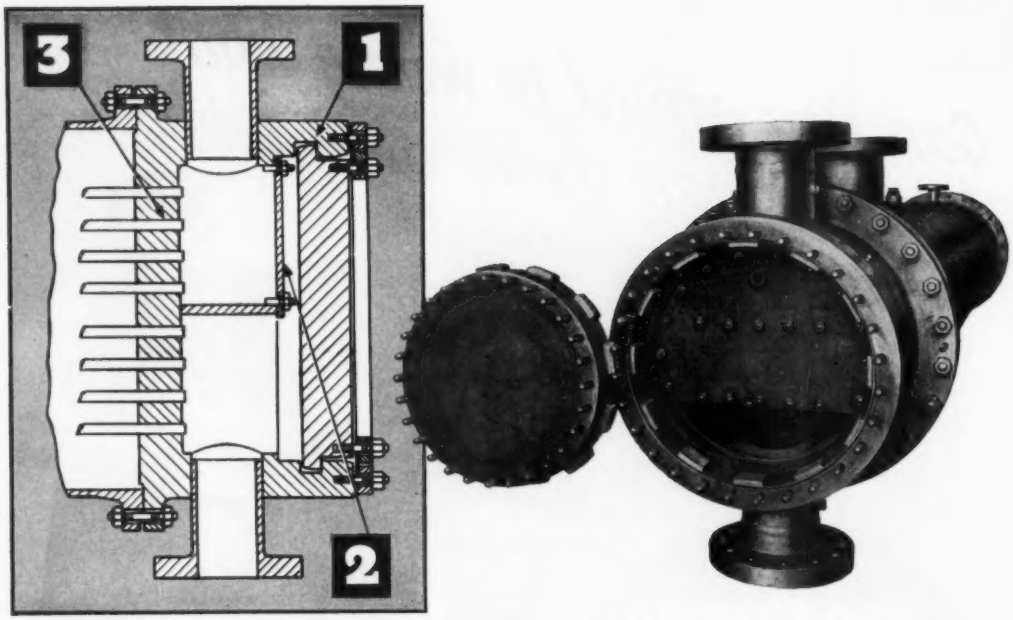
2. Iron Fireman Vertical Type Gas Burner
This gas burner is readily adaptable to a wide range of firebox dimensions and is easily installed in any conventional boiler setting. Zone fire control permits low-fire start and modulated firing. Low pressure gas. Capacities from 6 to 500 boiler h.p.

3. Iron Fireman Gas-Oil Combination
Iron Fireman Ring Type gas burner combined with Iron Fireman Horizontal Rotary oil burner permits quick fuel change to meet sudden emergencies, or avoid interruption during daily or seasonal gas shortages. Can also be combined with Iron Fireman Pneumatic Spreader stoker. Capacities up to 500 boiler h.p.

A survey in your plant, made without cost or obligation to you, will show you what you can save with Iron Fireman gas firing. For such a survey, or descriptive literature, write Iron Fireman Mfg. Co., 3132 W. 106th Street, Cleveland 11, Ohio, or call nearest Iron Fireman dealer.

IRON FIREMAN

AUTOMATIC FIRING EQUIPMENT FOR GAS, OIL, COAL



Your 3 WAY protection against leakage in this G-R Feedwater Heater

1 At the water head covers

You know how the barrel and breech block in big guns are locked by lugs or projections. The same effective closure principle assures complete tightness for the water head covers of G-R High-Pressure Feedwater Heaters. In these units, interlocking lugs carry the hydraulic load . . . therefore no need for the large number of heavy bolts required by other high pressure heater designs.

2 At the pass partitions

Here's a fruitful source of leakage that can't even be detected in many designs of feedwater heaters. You'll have no worry on that score with G-R Feedwater Heaters, because in these units the differential in water pressure between passes helps to keep the partition joints *tight* instead of tending to force them apart. The sketch tells the story.

3 At the tube sheet joints

83 Years of experience in building heat transfer apparatus have taught G-R how to make tube sheet joints *lastingly* tight. This unequalled experience . . . based on the results obtained in many hundreds of thousands of installed units . . . is your assurance of uniformly thorough tightness of all tube ends in every tube sheet.

Write for bulletin describing G-R Feedwater Heaters in detail.

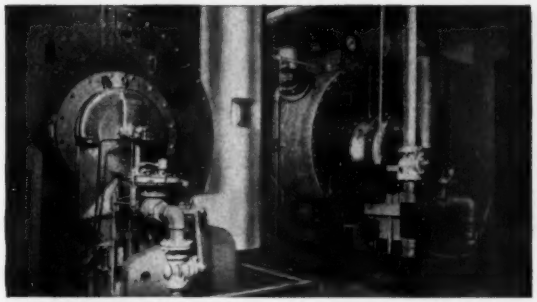
THE GRISCOM-RUSSELL CO., 285 MADISON AVE., NEW YORK 17, N. Y.

GR 260

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

"The Boiler-Room? — On the Roof, Sir"



The "First of Tulsa" Boiler Room — Two Cleaver-Brooks 200 hp. Gas Fired Boilers

Boiler-Room in the SKY..

Boiler Room Directly Behind Roof Sign

FIRST NATIONAL BANK OF TULSA
TULSA, OKLAHOMA

Carson & Lundin, *Architects*
Gaynor & Albright
Mechanical Engineers
John W. Harris & Associates
Supervisory Contractors
Manhattan Construction Co.
General Contractor
C. Wallace Plumbing Co.
Heating, Ventilating & Air Conditioning Contractor

FURTHER PROOF OF CLEAVER-BROOKS BOILER FLEXIBILITY

The new $6,000,000 First National Bank of Tulsa, one of the finest buildings in the Southwest, is heated with Cleaver-Brooks Self-Contained Steam Boilers.

For very good reasons the boiler-room was placed at roof level. (Boiler-room is directly behind roof sign at top of building, instead of conventional location in basement.) First, since it was a bank building, basement space was extremely valuable for vaults, storage, and air conditioning equipment. Then, too, with the fresh air intake on the top of the building, a considerable amount of piping was eliminated by placing the boilers at the same point. Since Cleaver-Brooks boilers require only a simple vent for carrying off combustion gases, long stack runs were eliminated, leaving additional valuable space within the building.

These are just a few of the many reasons why Cleaver-Brooks boilers were specified. Being completely self-contained and compact in design, requiring minimum head room and floor area, Cleaver-Brooks boilers presented no installation problem.

Cleaver-Brooks Self-Contained Boilers are available for oil, gas, combination oil and gas firing, 15 to 500 hp, 15 to 250 p.s.i., for heating and processing loads. Write for the catalog.

CLEAVER-BROOKS COMPANY
332 E. Keefe Avenue • Milwaukee 12, Wis.

Cleaver-Brooks
STEAM BOILERS
The First and Finest of their Class

Zallea Expansion Joint News

PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

Expansion Joint of the Month

WORLD'S 8 LARGEST JOINTS!

LOW PRESSURE TYPE

The Figure No. 8 Zallea Low Pressure Corrugated Expansion Joint is used to absorb vibration and protect machinery. Made of stainless steel, this joint is of the non-equalizing type and is limited in service to ½" maximum axial movement and 50 lbs. maximum pressure. Furnished with multiple corrugations, it is primarily used on condensers, turbines, stage bleeders, pumps, and between connected equipment where slight movement and

Figure No. 8 Type

vibration occur. Variations of the Figure No. 8 design are available in diameters up to 30 feet in diameter for low and medium pressure service. Where transportation limitations prevent shipment in one piece, arrangements can be made for on site manufacture. These units, like all Zallea Expansion Joints, are produced without circumferential welds in the corrugated element.

. . . a brand new 4-page folder on *all* Zallea Expansion Joints. Send for your copy of Bulletin 351 today!

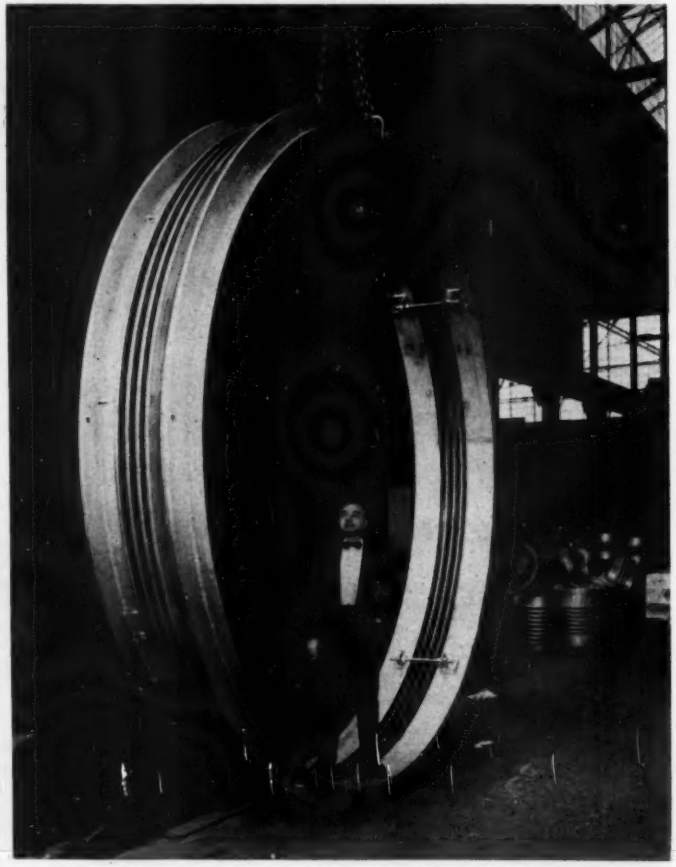
ZALLEA BROTHERS, 816 Locust Street, Wilmington 99, Delaware.

Keeping pace with expanding industrial needs, Zallea Brothers has just completed construction and delivery of the largest expansion joints ever built.

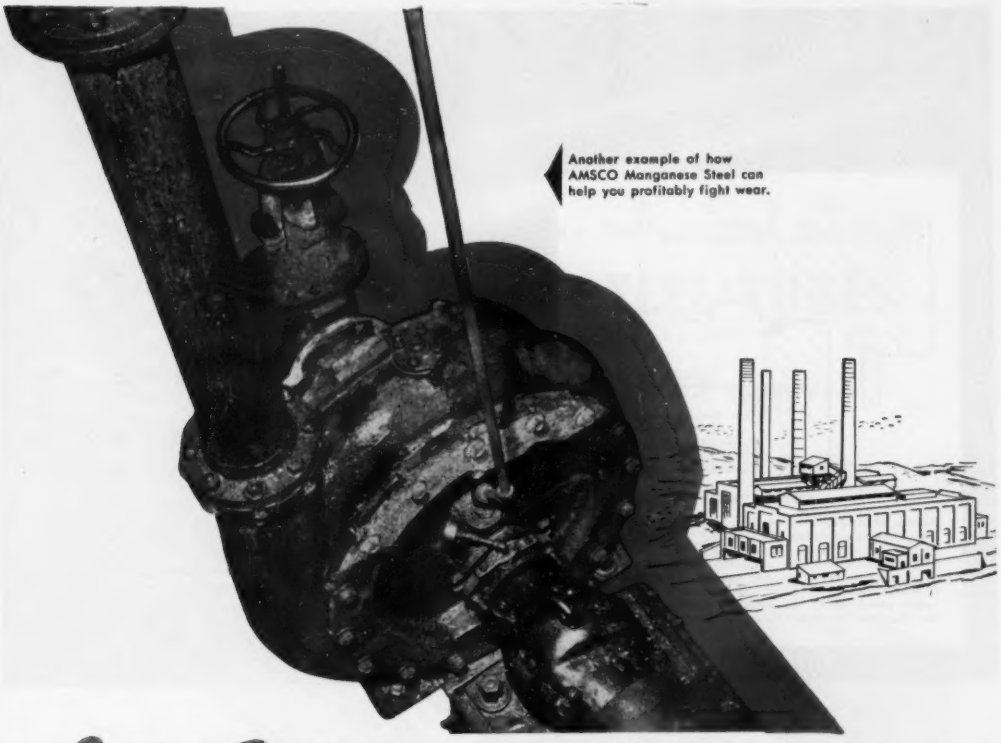
Thirteen feet in diameter, these Zallea Figure No. 8 Stainless Steel Expansion Joints, totaling 8 in number, are installed in a wind tunnel project at Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio.

These huge joints are installed in the header between the primary and secondary coolers in the altitude exhaust ducts which convey exhaust gases from full scale thermal jet engines, aircraft engines, turbines, burners and other equipment undergoing tests in simulated altitude conditions.

These Zallea Stainless Steel Expansion Joints are used in air service with a working pressure from vacuum to 60 pounds at a temperature between minus 50 to plus 65 degrees F.



(Advertisement)



Service Proved by 30 years of operation!

How an AMSCO Materials Handling Pump saved 65% on ash disposal costs

The Central Illinois Electric and Gas Co. at Rockford can speak with authority on the efficiency of AMSCO Materials Handling Pumps. They've been using these tough, wear-resistant pumps for 30 years! The photo above shows one of the first, if not *the* first pump of any make, used for ash disposal. This AMSCO Pump installation was put in service in June, 1921 and it's still in operation.

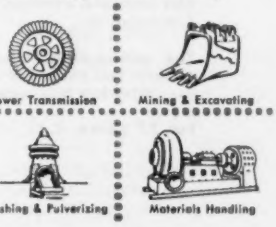
Naturally we're proud of its record. It cut ash disposal costs at this plant from $1.00 per ton way down to 35c per ton—*right from the start.* And, all through these 30 years, as replacements were necessary AMSCO Manganese Steel continued to be the most economical answer to the abrasive wear of ash.

These AMSCO Pumps are designed—and precision made—for a combination of efficiency and rugged service that means real economy. That's why so many hundreds of successful installations have been made since this first one in 1921.

WHEREVER YOU PUMP MATERIALS THAT CAUSE IMPACT AND/OR ABRASION . . .

. . . find out about longer-lasting, dollar-saving AMSCO Pumps. There's a size and type for every type of materials handling service . . . made by the world's largest producers of Manganese Steel castings for all industry.

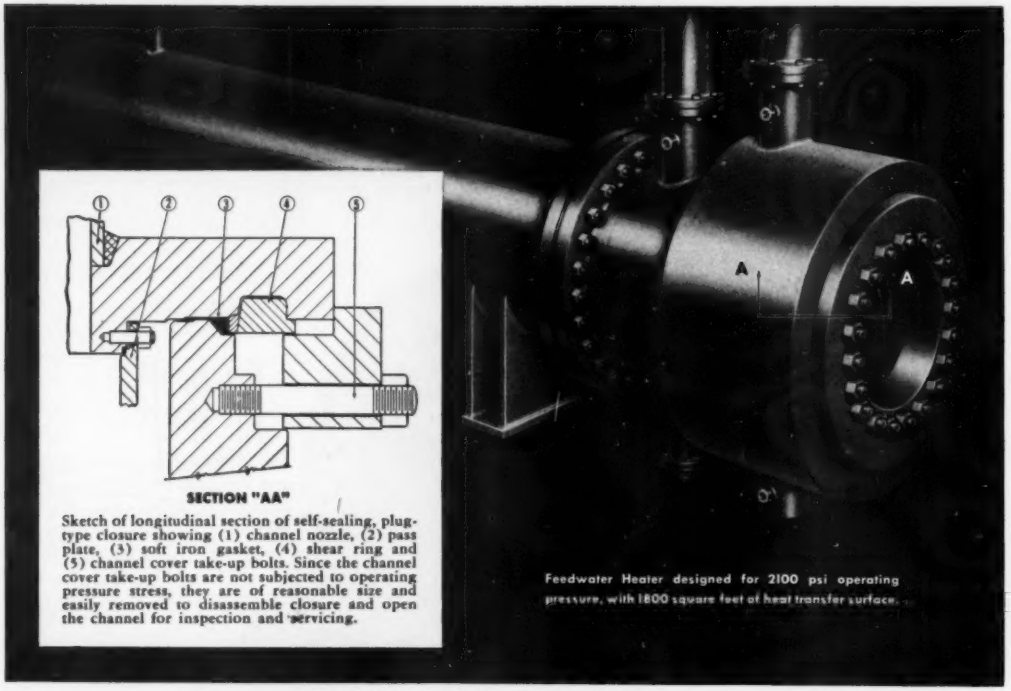
AMSCO controls impact and abrasive wear in 5 basic industrial operations:



Brake Shoe AMERICAN MANGANESE STEEL DIVISION

382 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.



SECTION "AA"

Sketch of longitudinal section of self-sealing, plug-type closure showing (1) channel nozzle, (2) pass plate, (3) soft iron gasket, (4) shear ring and (5) channel cover take-up bolts. Since the channel cover take-up bolts are not subjected to operating pressure stress, they are of reasonable size and easily removed to disassemble closure and open the channel for inspection and servicing.

Feedwater Heater designed for 2100 psi operating pressure, with 1800 square feet of heat transfer surface.

HIGH PRESSURE FEED WATER HEATERS

Call for A.O. Smith Design Features

Pressures of 1,000 to 10,000 psi are run-of-mill specifications at A. O. Smith!

With feedwater heater pressures exceeding 2,000 psi in power plant planning, A. O. Smith pressure-vessel and heat-exchanger design features find new and extremely important application. For example:

The self-sealing closure illustrated assures a positive seal under pressure. Still, it provides for easy servicing that means low maintenance.

For 77 years, A. O. Smith has been a leading fabricator of steel products and heavy industrial equipment. The first electric, arc-welded pressure vessel ever built was made by A.O.Smith in 1925.

Since that time, A. O. Smith has developed design features and manufacturing techniques that have set the pattern for the entire process equipment field.

Power plant design engineers and consultants are invited to bring their heat-exchanger requirements to one of the finest thermal design groups in this country.

Contact the nearest A. O. Smith office.

77th ANNIVERSARY 1874 1951

A.O.Smith

HEAT EXCHANGERS

Boston 16 • Chicago 4 • Cleveland 15 • Dallas 2
Denver 2 • Houston 2 • Los Angeles 22 • Midland 5, Texas • New Orleans • New York 17 • Philadelphia 3
Pittsburgh 19 • San Francisco 4 • Seattle 1
Tulsa 3 • Washington 6, D.C. • Milwaukee 1, Wisc.
International Division: P. O. Box 2023, Milwaukee 1

GLOBE

GLOBE TUBES

***Specialization* Gives You Uniform High Quality In**

STAINLESS STEEL TUBES

GLOBE *Seamless*

GLOWELD *Welded*

- **Ease of Fabrication**
- **Resistance to Corrosion and Oxidation**
- **Strength at High Temperatures**

Globe engineers gladly give you the benefit of specialized knowledge of stainless steel tubing in a wide range of services and applications — to improve your product — to cut costs.

GLOBE produces 26 standard analyses of stainless steel tubes —also special analyses when required.

Globe seamless stainless steel tubing may be had in sizes from ⅛ inch to 6⅝ inches O. D., and in pipe sizes ⅛ inch to 6 inches, standard, extra strong and double extra strong weights.

Gloweld electric welded stainless steel tubing may be had in sizes ranging from ¼ inch to 5 inches O. D. inclusive; in standard weight pipe (schedule 40) sizes ⅛ inch to 2 inches—lightweight pipe (schedule 5 and 10) ⅛ to 4½ inches inclusive.

Globe Steel Tubes Co., Milwaukee 46, Wisconsin

Chicago • Cleveland • Detroit • New York • Philadelphia • St. Louis
Houston • Denver • San Francisco • Glendale, Cal.

TYPICAL ANALYSES

301, 302, 302B, 304, 308, 309, 309S, 309Cb, 310, 314, 316, 316Cb, 317, 321, 329, 330, 347, 403, 405, 410, 416, 430, 443, 446
Inconel* Nichrome**

** Registered U. S. Trade-Mark.*
*** Trade-Mark Reg. U. S. Pat. Off.-D-H Co.*

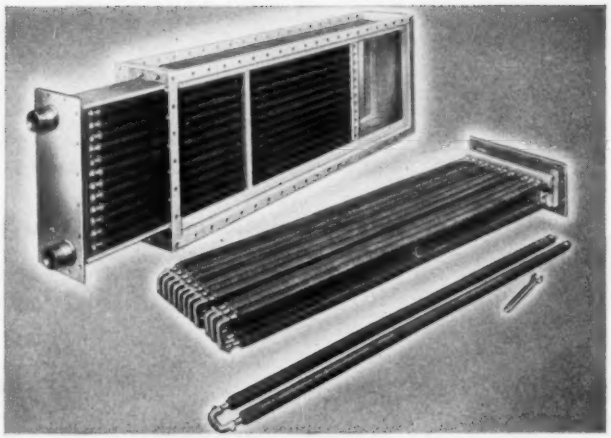
Write for bulletin 333 — Corrosion and Heat Resisting Steel Analyses Chart — a valuable reference tabulation of stainless steel analyses as produced by various manufacturers.

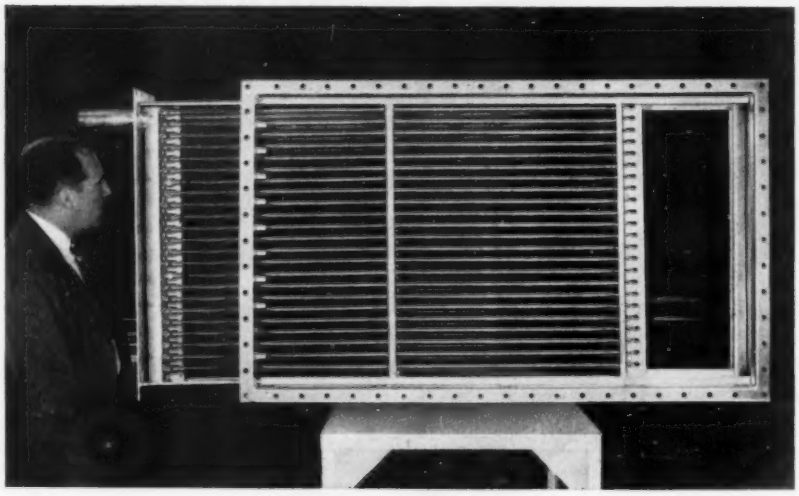
Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe Welding Fittings.

Facts you should know about

AMERICAN BLOWER HEAVY DUTY STEAM COILS

American Blower's Type H Heavy Duty Steam Coil has been developed for a single purpose: to furnish public utilities and industry with a heating coil designed and built in accordance with highest quality industrial equipment standards. It is a coil possessing strength, corrosion resistance and complete accessibility.





↑ Above, Type H Heavy Duty Coil and component parts. The entire heating element is removable from the casing and can be completely dismantled for inspection, maintenance and repair. Individual tubes are replaceable.

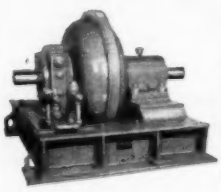
← Type H Coils are available in a wide range of sizes and are designed, tested and guaranteed for operation with steam pressures to 350 lbs. gauge. Casing is heavy steel, welded airtight.

For detailed information on American Blower Type H Coils, write for Bulletin B-1318, or call our nearest branch office.

And if you'd like complete data on other American Blower power plant equipment — Mechanical Draft Fans, Fly Ash Precipitators and Gyrol Fluid Drives for boiler feed pumps and fan control — write, stating your requirements, or phone the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation



Gyrol Fluid Drives

for Mechanical Draft Fans are also a part of American Blower's wide range of products which serve America's leading public utilities.

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Hi Neighbor!

WE'RE "NEXT DOOR" TO YOU

Perhaps not exactly next door—but, close enough to be neighborly. For instance, there is a Refinite man who can be in your plant within a few hours—and at the most a day or two.

To the Refinite Corporation, being neighborly means:
1—Right Answer to your water treating problem — the answer that saves you money and gives you what best fits the requirement.
2—Giving Continuous Service—a true neighbor, dependable in time of need.

That is why Refinite has established as "neighbors" to you, Sales & Service Engineers whose activities blanket the entire United States. One of those neighborly Engineers lives in your area, and is quickly, easily available. He has had years of experience and is thoroughly trained to help you with your water treating problem—seeing that you get the Right Answer and Continuous Service.

SET UP TO GIVE YOU CONTINUOUS SERVICE!
THE RIGHT ANSWER NEVER FAILS!
NEIGHBORLY-SALES & SERVICE CERTIFICATE
Goes with EVERY Refinite Sale
REFINITE HAS THE RIGHT ANSWER TO...
WATER SOFTENING
DEMINERALIZING

Pictured above is the largest pressure-zeolite water softening plant in the United States installed at the Twin Cities Ordinance Plant, New Brighton, Minnesota, by **The Refinite Corp.** Daily capacity is over 9 million gallons of zero hardness water. The RIGHT ANSWER to a tough problem, solved by **Refinite.**

Shown here is one of the successful four-bed demineralizers which produces water that is chemically pure. Refinite demineralizers frequently give chemically pure water at a saving of 50% to 90% over the cost of distilled water. These are available in four, two and mixed bed units.

Refinite

WATER REFINING EQUIPMENT

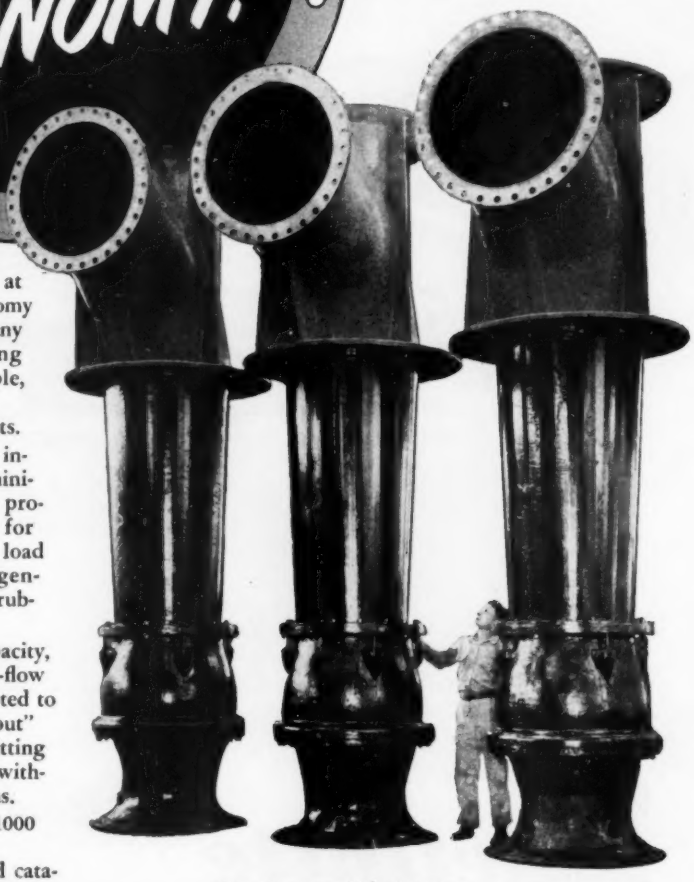
OMAHA, NEBR.

Want to be Neighborly?

Do you want the RIGHT ANSWER to your water softening or demineralizing problem? Let Refinite send you especially prepared, pictorial literature that shows how Refinite helps get the "Right Answer." Then, if you want a Refinite Neighbor to call on you, write, wire or phone collect. Norman Tucker, Sales Manager at Refinite. Address: Refinite Corp., Box 1312, Omaha, Nebraska.

pumping LARGE volumes?

LOOK TO ECONOMY!



Economy mixed-flow pumps, each 28,000 G. P. M., 35-ft. TDH, 575 RPM, for condenser circulation in Georgia public utilities plant.

You can deliver more water, fresh, contaminated or sea, at lower over-all cost, with Economy mixed-flow pumps than with any other type efficient pumping equipment! Compact and simple, they are designed for large capacity, low head requirements.

Impellers, close to the pump inlet to keep submergence to a minimum, are carefully designed to produce the proper capacities, and for efficient operation during all load requirements. Bearings are generally of the water-lubricated rubber type.

Well suited to any large capacity, low head job, Economy mixed-flow pumps are especially well adapted to condenser circulation. "Pull-out" types are also available, permitting removal of all operating parts without disturbing pipe connections.

Standard sizes range from 1000 to 100,000 G.P.M.; specials to 200,000 G.P.M. For details and catalog No. G-349, write Dept. BC-6.

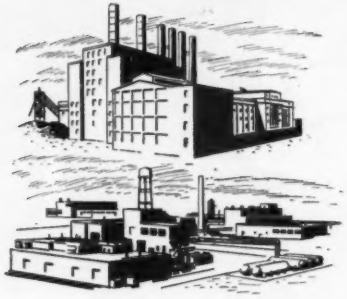
When it's pumps, think of Economy

Centrifugal, axial and mixed-flow pumps for all applications.

Economy Pumps, Inc.

DIVISION OF HAMILTON-THOMAS CORP. HAMILTON, OHIO

They're investing millions where mining *pays!*



→ In the Bituminous lands of the B&O, progress never stops. Year after year, enterprising coal producers back their faith in B&O coals with new mines and processing plants, with increased mechanization and up-to-the-minute equipment.

B&O Bituminous lends itself to modern, low-cost mining. Because of its nearness to America's industrial heart, transportation costs are moderate. Markets are dependable, and there is a wide variety of coals to meet all needs.

Smart consumers "bank on B&O Bituminous"—its sources and reserves are known and great.

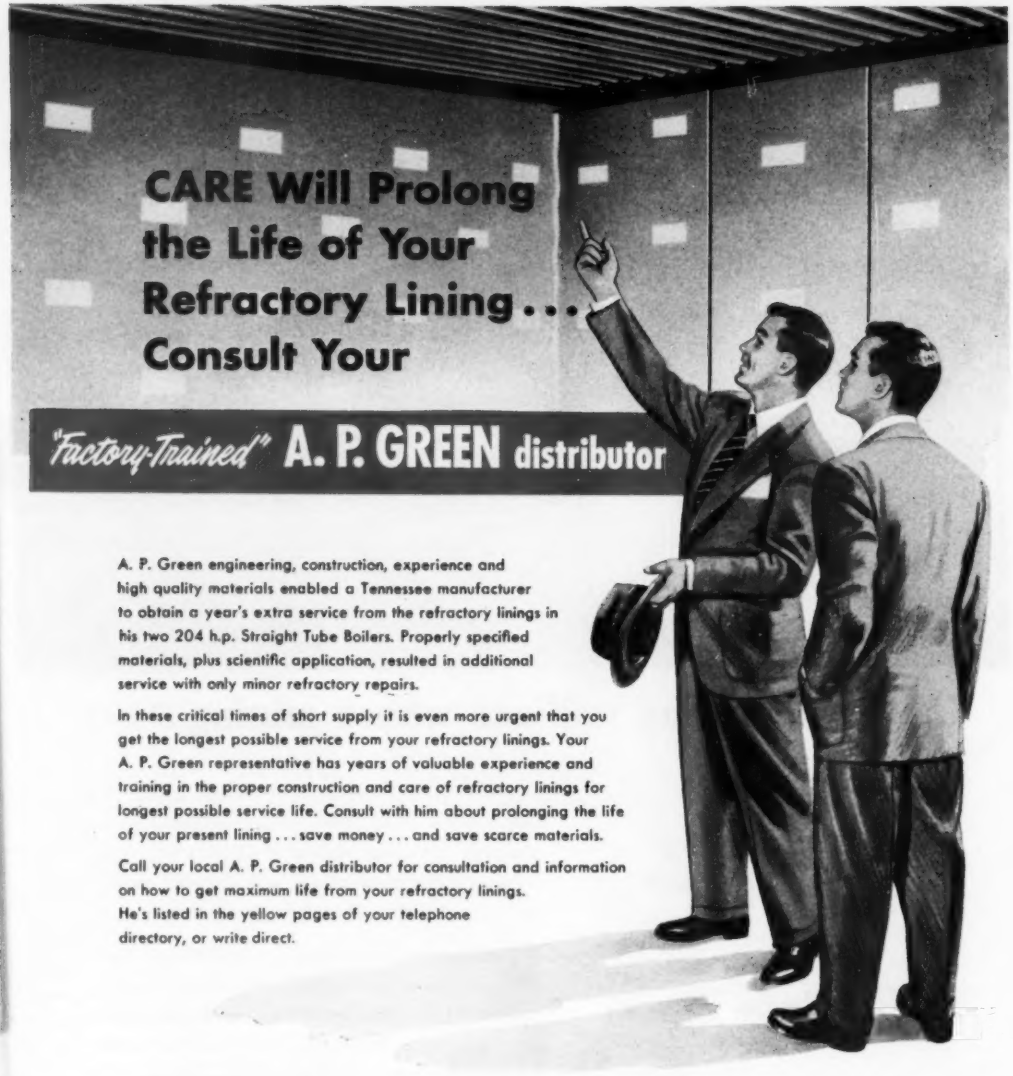
Ask our man!

BITUMINOUS COALS FOR EVERY PURPOSE

LINKING 13 GREAT STATES WITH THE NATION
B&O

BALTIMORE & OHIO RAILROAD

Constantly *doing things* **—better!**



CARE Will Prolong the Life of Your Refractory Lining... Consult Your

"Factory-Trained" A. P. GREEN distributor

A. P. Green engineering, construction, experience and high quality materials enabled a Tennessee manufacturer to obtain a year's extra service from the refractory linings in his two 204 h.p. Straight Tube Boilers. Properly specified materials, plus scientific application, resulted in additional service with only minor refractory repairs.

In these critical times of short supply it is even more urgent that you get the longest possible service from your refractory linings. Your A. P. Green representative has years of valuable experience and training in the proper construction and care of refractory linings for longest possible service life. Consult with him about prolonging the life of your present lining... save money... and save scarce materials.

Call your local A. P. Green distributor for consultation and information on how to get maximum life from your refractory linings. He's listed in the yellow pages of your telephone directory, or write direct.

There's an A. P. Green refractory product applicable to each type of service requirement in all types of industry:

SUPER-PLASTIC, for service where operating conditions are unusually severe

PLASTIC QUIK-PAK, a high duty plastic refractory

KAST-SET, a high quality refractory castable

KAST-O-LITE, lightweight castable refractory with insulating properties.

A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

In Canada:
A. P. GREEN FIRE BRICK CO., Ltd.
Toronto 15, Ontario

A. P. Green
REFRACTORY PRODUCTS

Distributors in the Principal Cities of the World

1
90° RIGHT OR LEFT SIDE ANGLE FOR SIDE INSTALLATIONS.
Can be tipped forward or backward for eye level reading.

2
STRAIGHT INDUSTRIAL THERMOMETER
for inserting on horizontal pipe lines.

From any angle

Easy-Reading Taylor Industrial Thermometers invite frequent readings for better protection of your equipment.

1 **Exclusive,** three-times-easier-to-read Binoc* tube actually invites *frequent* reading.

2 **Extra-bold** black numerals stand out sharply on white background.

3 **Fast, accurate** indications of all temperatures within minus 40° to plus 950°F., or equivalent Centigrade.

4 **Built** to give you many years of rugged, dependable service.

5 **Available** with a wide variety of stems and connections. Write for CATALOG E today!
Taylor Instrument Companies,
Rochester, N.Y., and Toronto, Canada.

*Registered Trade-Mark

3
135° OBLIQUE RIGHT OR LEFT SIDE ANGLE
for difficult locations.

4
90° ANGLE INDUSTRIAL THERMOMETER
for vertical pipe lines.

Taylor Instruments MEAN ACCURACY FIRST IN HOME AND INDUSTRY

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

AMAZING "Ultrasonic" EYE
Sees Through Metal

at
Pittsburgh Piping
AND EQUIPMENT COMPANY

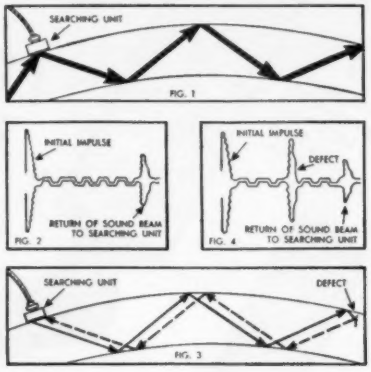
The illustration above shows P.P.&E. high pressure, high temperature piping being tested by means of a Reflectoscope which produces pulses of vibration waves of a frequency above hearing and transmits them at an angle into the metal through a searching unit which contains a sensitive quartz crystal.

The slightest discontinuity in the metal interrupts transmission of the waves, reflecting them back to the searching unit where the crystal converts mechanical vibrations into electrical energy. This voltage, amplified in the receiver, produces a visual indication of the defect on the screen of a cathode ray tube.

This unique testing method can detect flaws that can be found by no other non-destructive test. Its use assures quality control of materials and welding.

Look to Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

How the *"Ultrasonic"* Eye Works



Intermittent ultrasonic vibrations are transmitted angularly into the section under inspection, so that each sound beam is reflected away from its point of origin progressively from inner to outer pipe wall surface in a consistent pattern, as shown in Fig. 1, until it circles the pipe and returns to the searching unit. The uninterrupted flow and return of the beam is indicated on the oscilloscope screen as diagrammed in Fig. 2. Any discontinuity in the metal lying in the path of the sound beam will interrupt transmission as shown in Fig. 3, reflect the sound back to the searching unit, and provide a visual indication of its presence and location on the oscilloscope screen (see Fig. 4).

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street — Pittsburgh, Penna.

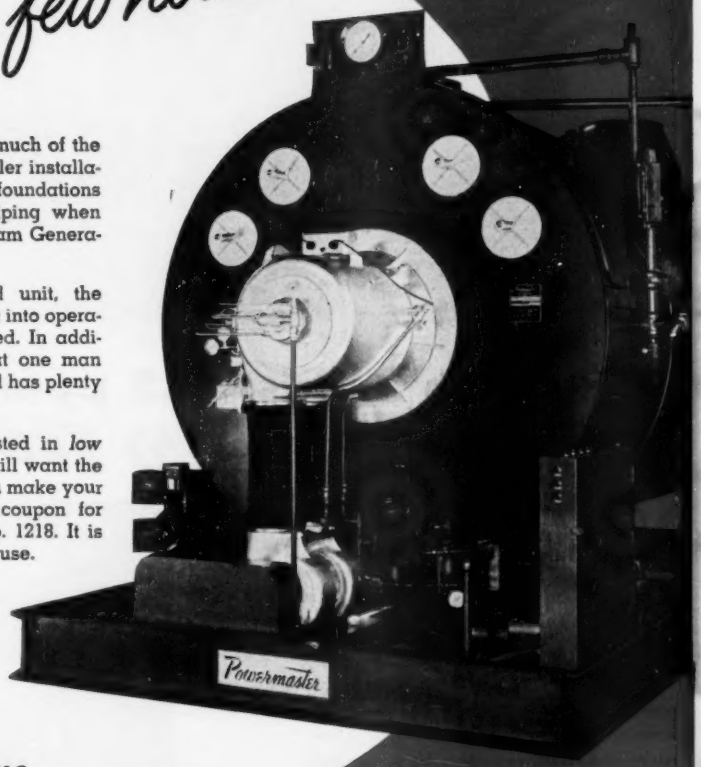
EASY TO INSTALL

in just a few hours

Now you can do away with much of the time and money spent for boiler installation. No costly stacks, brick foundations or assembly of extensive piping when you get the *Powermaster* Steam Generator.

A completely self-contained unit, the *Powermaster* can often be put into operation on the day it is delivered. In addition, many users tell us that one man operates the *Powermaster* and has plenty of time for his other duties.

Then too, if you are interested in *low* cost steam generation, you will want the *Powermaster* story before you make your investment. Just return the coupon for your copy of our Bulletin No. 1218. It is full of information you can use.



To meet your special needs, the *Powermaster* is made in sizes from 15 to 500 H. P. and pressures from 15 to 200 p.s.i. You can use light or heavy oil, gas or combination gas/oil firing.

ORR & SEMBOWER, INC.
Established 1883

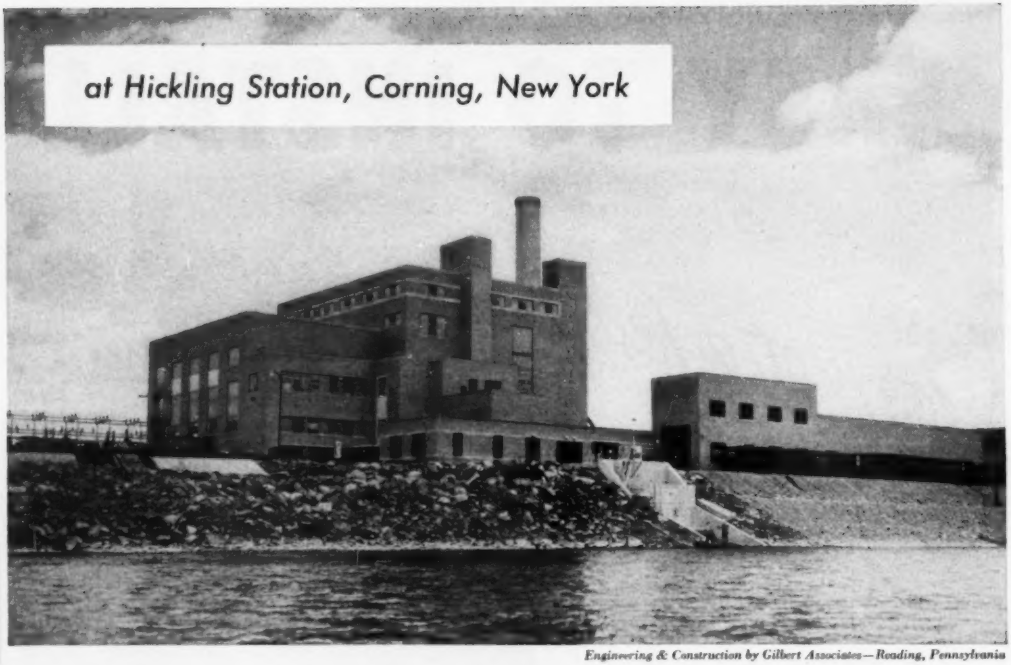
Powermaster

STEAM GENERATORS
AND HOT WATER BOILER UNITS

Orr & Sembower, Inc.
870 Morgantown Road, Reading, Penna.

Please mail Bulletin No. 1218, showing how easy it is to install and operate *Powermaster* Steam Generators and Hot Water Boiler Units.

Name ..... Title .....
(PLEASE PRINT)
Company .....
Address .....
City ..... Zone ..... State .....



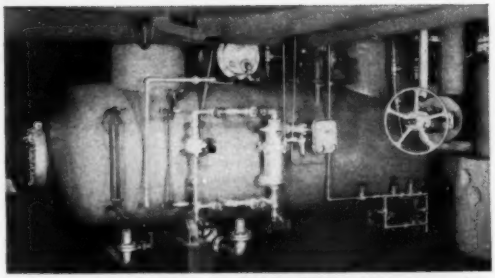
Engineering & Construction by Gilbert Associates—Reading, Pennsylvania

Maximum Solids—0.5 ppm
With an ALCO Evaporator

From the fast-moving coal conveyor to the powerful 30,000 kw. generator, every operation is geared for the swift, efficient production of power at the Hickling Station of the New York State Electric & Gas Corporation.

Typical of this efficiency is an ALCO evaporator of new design which performance tests show will produce vapor with maximum solids carryover of 0.5 ppm or less. Such ALCO features as a special vapor scrubber and an exclusive integral deaerating heater insure top performance of this unit. The deaerating section, for example, is fully effective so that ALCO guarantees feedwater leaving this section to have zero free carbon dioxide content and 0.03 cc. of oxygen per liter.

Check these other Alco design features . . . exclusive "flex-tube" action for descaling . . . separate, removable channel and cover . . . patented ALCO compression bolting . . . all add to the efficiency of the evaporator. Write now for more details or call the nearest ALCO Sales Engineer at Chicago, Cleveland, Houston, Kansas City, Los Angeles, New York or Tulsa. Plants at Dunkirk, N. Y. and Beaumont, Texas.

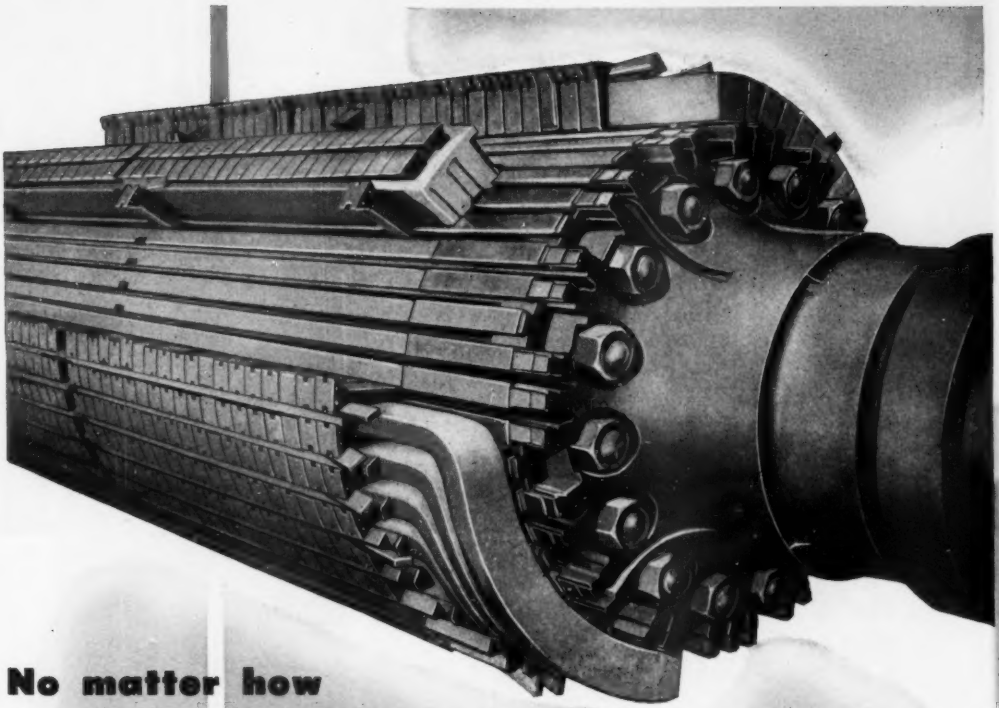


New design ALCO *Evaporator on the job at Hickling Station. Capacity, 7000 pounds of water per hour at 238.3° F. and 24.2 p.s.i.a. when supplied with steam at a pressure of 56.5 p.s.i.a.*

ALCO

ALCO Products Division
AMERICAN LOCOMOTIVE COMPANY

In step with tomorrow—ALCO AIRCOOLERS, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe



No matter how unusual your generator may be . . .

we can build New-Born Power into it!

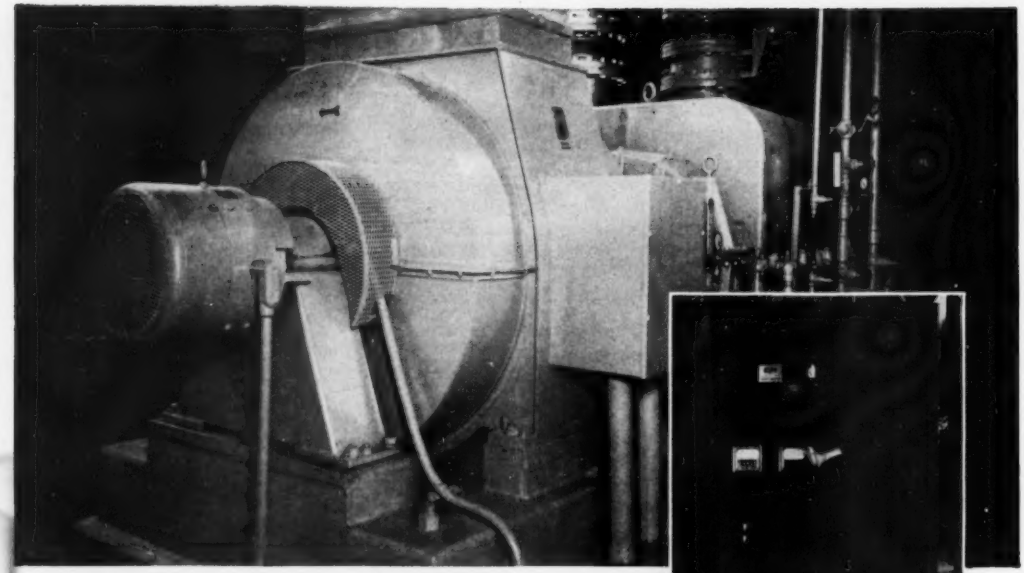
Peculiarities of design such as those in the turbo-alternator rotor above, photographed in our shop, hold no terrors for National Electric Coil engineers. In this case, removable tooth-sections allow the field coils to be hot-pressed and seasoned as a complete coil unit. Each finished coil is placed on the rotor core and the tooth-sections are inserted. National is prepared, by experience and equipment, to take advantage of every opportunity afforded by design and construction to give you maximum power and life. *Now* is the time to make sure your rotating electrical equipment is ready for the job which lies ahead. Write or wire (or cable Natcoil, Columbus).

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—

—DESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES



24 HR. LIFEGUARD FOR PENICILLIN AT SQUIBB.....

How Motor and Control Team Up To Keep Penicillin Growing

Gigantic fermenting tanks continuously aerated with sterile air . . . this is where penicillin is born . . . a rigidly controlled around-the-clock process at the New Brunswick, N. J. laboratories of E. R. Squibb & Sons.

The 12,000 cfm centrifugal blower pictured above helps provide the air supply which must bubble non-stop into the fermenting medium so the living penicillin cultures may breathe and grow. This is critical, for if the air supply fails, it means *sudden death* to the growing penicillin . . . a serious product loss and much wasted time, for each tank must be thoroughly cleaned and re-sterilized if a batch is spoiled.

Motor and control *must* keep the air-supplying blower running continuously during the fermenting operation. The 1500 hp, 1200 rpm, unity-power-factor E-M Synchronous Motor shown above, coordinated with an E-M Hi-Fuse Control, is specifically designed to *keep running* . . . guard the life of penicillin, and save costs!

Time Delay Undervoltage Protection

To keep the motor running through voltage dips, time delay undervoltage protection is provided by d. c. latching. With this ingenious method, the main switch and field relays are held closed by direct current. If a voltage dip occurs, the motor keeps running and may even stay in synchronism if the dip is short.

Part Winding Control

Another advantageous feature of this E-M Motor and Control is E-M-invented Part Winding Starting. This starts the motor in easy steps and avoids any sudden dangerous strains on the line from starting current inrush which might knock out other plant equipment.

This same coordination of E-M Motors and Control may be your answer to some particular problem. For drives that require skilled engineering to meet specialized requirements, you should find out what E-M has to offer. Your nearest E-M field engineer will be glad to show you the facts and figures on how E-M can serve you.

E-M HIGH-SPEED SYNCHRONOUS MOTORS
Are described in E-M Publication No. 181
Write for your copy today

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

1100-TPA-2100

Everything you want IN A COMPLETE LINE OF GENERAL SERVICE END SUCTION PUMPS

THEIR APPLICATION IS GENERAL BUT THEIR RESULTS ARE SPECIFIC

LOW COST: Mass production methods, high volume, modern factory facilities insure a reasonably priced product. Highest quality materials and workmanship, rigid inspection, and proper design insure a superior product at this reasonable price.

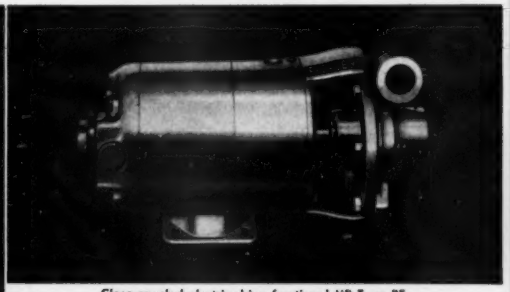
SAVE ON SERVICE: Hydraulic characteristics are superior, insuring lowest operating cost over the longest time. Servicing is held to a minimum due to the inherent features of construction, for example: Fractional sizes furnished standard with mechanical seal; extra wide and deep stuffing box on all integral sizes. Integral sizes available with simple, fool-proof mechanical seal, at slight extra cost.

PEAK PERFORMANCE: The Peerless Fluidyne line was designed with high efficiency in mind. Comparison with other makes will prove that Peerless furnishes peak performance, size for size. Two types, direct-connected electric drive (Type PE) and V- or flat belt pulley or flexible coupled drive (Type PB), meet every installation requirement.

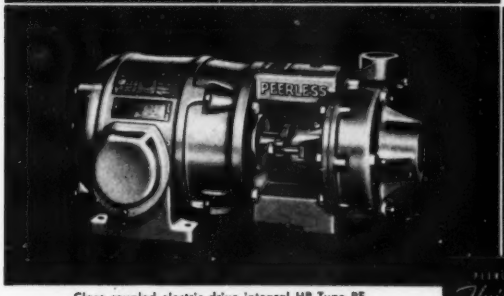
BROADEST RANGE OF SIZES AND CAPACITIES: Peerless manufactures the *complete* line of pumps. Available in all sizes and capacities from ¾ to 150 h.p., 10 to 5500 gpm, and heads to 260 ft. Most sizes and types carried in factory stock, available either from Indianapolis, Indiana or Los Angeles, California.

PEERLESS *Fluidyne* PUMPS

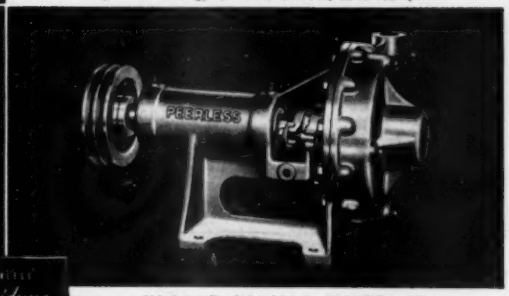
VERSATILE • EFFICIENT • ECONOMICAL



Close-coupled electric drive fractional HP Type PE
Capacities: to 65 gpm; Heads: to 110 ft; ¼ to 1½ hp.



Close-coupled electric drive integral HP Type PE
Capacities: to 1000 gpm; Heads: to 200 ft; up to 60 hp.



V-belt (or flat belt) drive integral HP Type PB
Capacities: to 5500 gpm; Heads: to 260 ft; up to 150 hp.

NEW BULLETIN describes additional features of pumps in the Peerless Fluidyne line. Write for your copy of this 24-page fully illustrated and descriptive engineering bulletin today.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address Inquiries to Factories at:
Los Angeles 31, California or Indianapolis 8, Indiana
Offices: New York, Atlanta, Fresno, Los Angeles, Chicago, St. Louis, Phoenix; Dallas, Plainview, Lubbock, Texas; Albuquerque, New Mexico.

MAIL COUPON TODAY

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Los Angeles 31, California

Please send me a copy of Peerless Fluidyne Pump Bulletin No. B-2300.

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COMPANY_____

STREET_____

CITY_____ STATE_____

POW

"S" MONEL

A casting alloy offering extra hardness at elevated temperatures, pronounced resistance to galling and seizing, and excellent corrosion resistance.

One of the hardest and strongest of the non-ferrous casting alloys, "S"® Monel is particularly suitable for parts subject to high stress and severe friction under corrosive conditions.

"S" Monel's low coefficient of expansion, high density and corrosion resistance enable it to give excellent service where clearances are small and operating temperatures subject to considerable variation.

The principal characteristics of "S" Monel are:

• • •

Typical Applications of "S" Monel

valve discs	bushings
valve seats	sleeves
impellers	ejector nozzles
wear rings	direct-acting pump liners

Mechanical Properties of "S" Monel*

(Age-hardened)

Yield Point	80-115,000 psi
Tensile Strength	120-145,000 psi
Elongation in 2-in.	4-1%
Hardness (Brinell)	300-375
Coefficient of Thermal Expansion (32°-212°F.) in./in/°F.	.0000068

Hardness of "S" Monel at Elevated Temperatures*

(As-cast condition)

Temperature, °F.	Brinell Hardness
Room	321
700	321
800	311
900	311
1000	321
1050	335
1100	293

*Average properties—not to be used for specification.

Hardness: "S" Monel can be age-hardened to 300-375 Brinell. It retains this hardness even at elevated temperatures. (See table.)

Resistance to Galling: "S" Monel is superior to most other hard metals in its ability to resist galling under severe conditions of pressure and friction. Often where lubrication is poor or absent entirely, "S" Monel has shown unusual resistance to seizing.

Corrosion Resistance: "S" Monel is relatively unaffected by most commonly-encountered corrosives . . . reducing acids, organic acids, acid and neutral salt solutions, strong alkalies, dry gases, and most atmospheres.

Erosion Resistance: Because of high hardness and toughness, "S" Monel resists damage caused by cavitation, erosion, "wire drawing," and particle abrasion.

Machinability: "S" Monel can be machined as-cast, and preferably so when only a moderate amount of machining is to be done. For extensive machining, the castings may be softened to 235 Brinell by heat treatment. Subsequent heat treatments can restore hardness to the level of 300-375 Brinell.

Weldability: "S" Monel is *not* recommended as a weldable material.

Additional Engineering Data Available

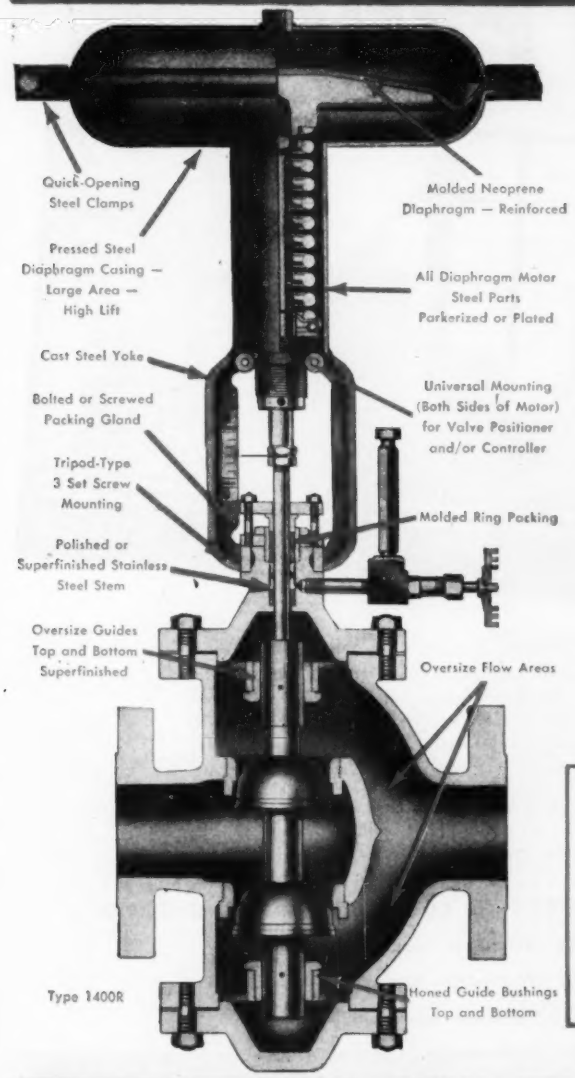
As you know, nickel alloys are currently in very heavy demand. But why not let INCO *help you in your long-range planning — particularly if your plans involve a choice of corrosion-resisting materials? A letter outlining your problems brings technical assistance, helpful data. Write* INCO's *Technical Service Station.*

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
NICKEL INCO ALLOYS

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"®

K&M ADVANCED-TYPE VALVE FOR EXACTING CONTROL


Quick-Opening Steel Clamps
Pressed Steel Diaphragm Casing — Large Area — High Lift
Cast Steel Yoke
Bolted or Screwed Packing Gland
Tripod-Type 3 Set Screw Mounting
Polished or Superfinished Stainless Steel Stem
Oversize Guides Top and Bottom Superfinished
Type 1400R
Molded Neoprene Diaphragm — Reinforced
All Diaphragm Motor Steel Parts Parkerized or Plated
Universal Mounting (Both Sides of Motor) for Valve Positioner and/or Controller
Molded Ring Packing
Oversize Flow Areas
Honed Guide Bushings Top and Bottom

K & M Diaphragm Control Valves embody the accessibility and other desirable features of the "open yoke", formerly available only in cast iron construction, together with the strength and resistance to shock found only in steel.

The diaphragm casing assembly is the exclusive K & M Boltless Duoseal design which allows quick disassembly. The large diaphragm is molded so there is full effective contact with the diaphragm button during the complete valve stroke. This construction, together with heavy, calibrated, long-travel springs gives an unusually high power factor for extremely precise control.

Flow passages of the valve body have a minimum average area of 140% of comparable size pipe area; inner valve open free areas average 80% of pipe area. This design permits pressure drop to take place principally through the inner valve, assuring complete control over the full valve stroke.

Send for K & M Bulletin S10 for details and data.

K&M SERIES 1200 and 1400

Available sizes — ½ to 16 inches.

Construction — Cast iron, carbon and stainless steels and most machineable alloys.

Inner Valves — A wide range of styles and characteristics to meet varying requirements.

Action — Designed for direct or reverse action.

KIELEY & MUELLER

Established 1879

2031 - 43rd STREET NORTH BERGEN, N. J.

The modern K & M line includes Diaphragm Control Valves, Liquid Level Controls, Pressure Pilots and related equipment for steam, gas, air, oil and liquid service. Ask for K & M catalogue 47.

BRINGING YOUR
COAL HANDLING COSTS

Down to Earth

Concrete Silo Storage with live storage shelf, track hopper, double-chain bar feeder, centrifugal discharge bucket elevator, scale and monorail bucket.

Tile Silo Storage with track hopper, bar feeder, bucket elevator, 2000 lb. weigh larry.

Cylindrical Steel Tank Storage with feeder and conveyor.

Suspended Steel Bunker Storage showing bunker and weigh larry.

When coal handling costs are too high for comfort, remember Gifford-Wood's 4-basic design story. Each of these storage designs—concrete silo, tile silo, cylindrical steel tank and suspended steel bunker—are carefully engineered to meet specific limitations of climate, capacity, space available and cost. The combination of extensive engineering experience and well known manufacturing ability assures installations of highest possible operating efficiency at reasonable cost.

A Gifford-Wood engineer, thoroughly familiar with coal handling problems, is at your service. Let him study your needs and recommend a G-W system that will both simplify the operation and reduce your costs.

4

BASIC G-W WAYS TO CUT COAL HANDLING COSTS

1. Reinforced Concrete Silo Storage
2. Vitrified Tile Silo Storage
3. Cylindrical Steel Tank Storage
4. Suspended Steel Bunker Storage

Bulletin No. 300 describes, with illustration and working drawing, these 4 basic G-W types of handling systems. Write today for your copy.

GIFFORD-WOOD CO.

SINCE 1814
Hudson, N. Y.

NEW YORK 17
420 LEXINGTON AVENUE

CHICAGO 6
565 W. WASHINGTON STREET

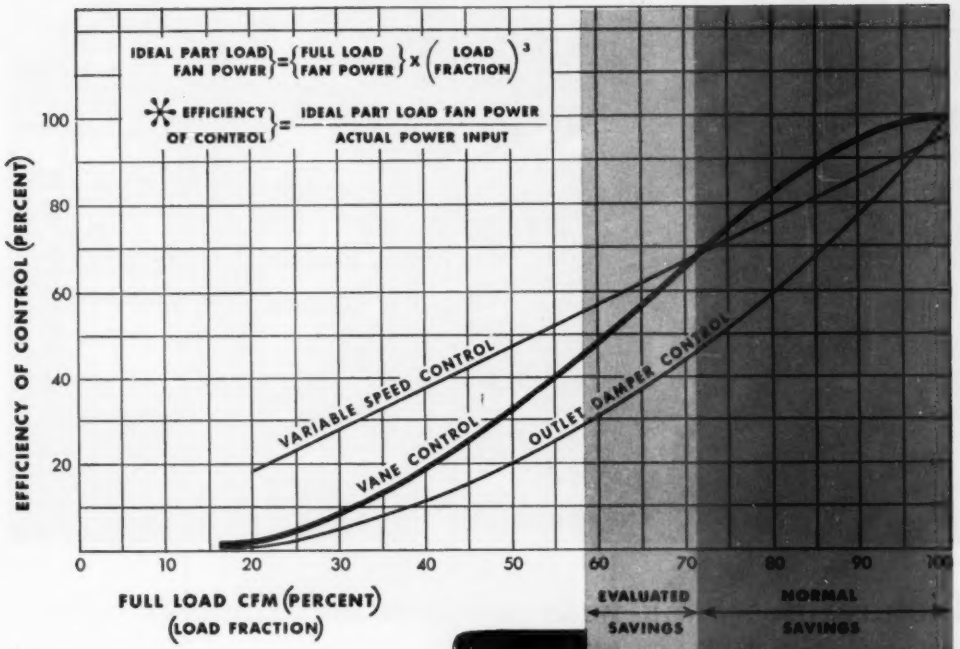
ST. LOUIS 1
RAILWAY EXCHANGE BUILDING

6378

G-W HANDLES IT . . . faster • easier • cheaper

FOR PART LOADS

USE STURTEVANT VANE CONTROL® FOR HIGH EFFICIENCY AT LOW COST



If you operate in this range—and most plants do—VANE CONTROL is the economical choice

Have you ever considered the relative efficiencies of methods of mechanical draft fan volume control—and then evaluated them against first cost? Do so, and you will find Sturtevant Inlet VANE CONTROL is the best. It is high in *efficiency of control** and low in first cost.

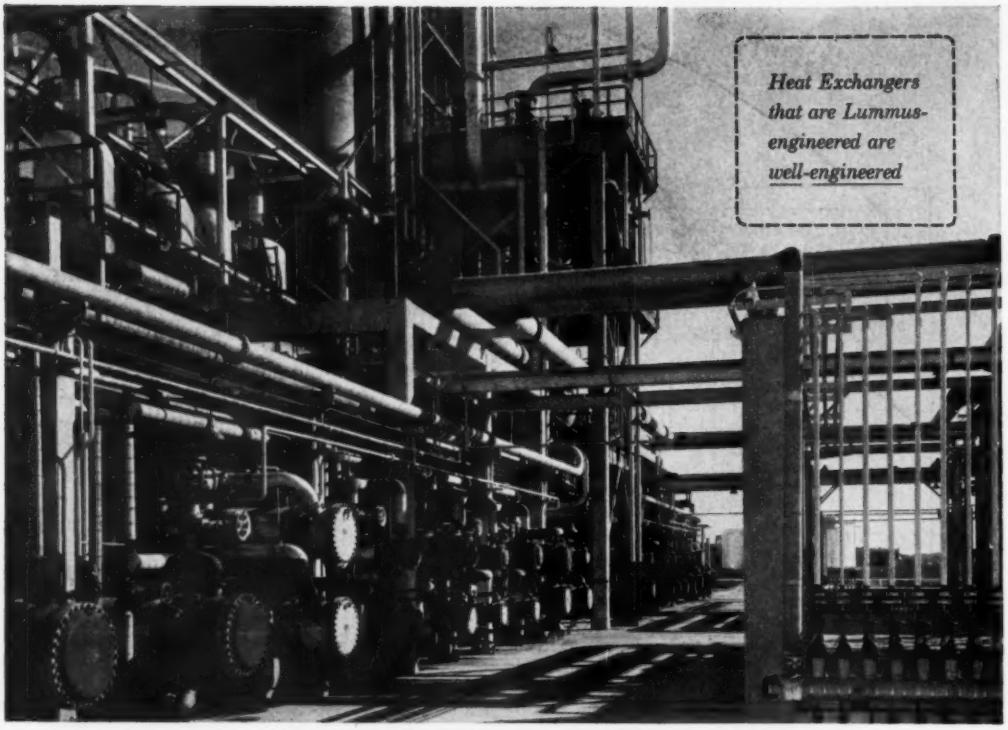
Whether for forced or induced draft, the *new* VANE CONTROL is a simple and reliable regulator of fan output—a control which responds instantly to varied demands, and yields major power savings at reduced loads.

A new Bulletin, DB 92-810, describes the mechanical improvements developed for Sturtevant VANE CONTROL and its use in mechanical draft, industrial and ventilating applications. Write today for a free copy. Westinghouse Electric Corp., Sturtevant Division, 151 Damon St., Hyde Park, Boston 36, Mass.

YOU CAN BE SURE...IF IT'S **Westinghouse**

PUTTING *Air* TO WORK

J-80220



Picture of a bank with a favorable exchange rate

No marble, vaults, or tellers' windows here! This is a bank of Lummus Heat Exchangers. They are part of Cit-Con Oil Corporation's 12,500 B/D "Twin" Vacuum Distillation Units at the Lake Charles, La., refinery.

They're paying off, too! Reflecting the design ingenuity of Lummus engineers, these units are helping to achieve maximum heat economy . . . hence lower lube oil manufacturing costs.

What's more, with better than a year's operation behind them, they have a record of rock-bottom maintenance and upkeep. The same is true of Lummus exchangers installed in M. E. K. Dewaxing Units No. 1 and No. 2 at the same site. In short, all Lummus exchangers have made a worthy contribution to Cit-Con's excellent on-stream record at Lake Charles.

This is typical of the contributory job being done by Lummus heat transfer equipment of all types, for all industry. See that *your* next job goes to Lummus.

THE LUMMUS COMPANY

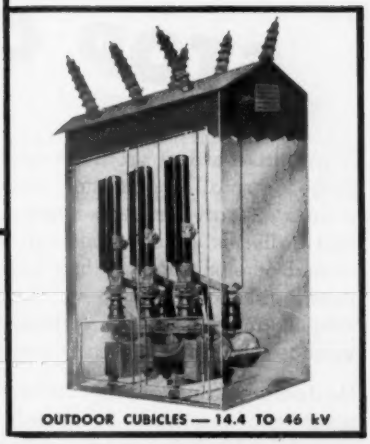
HEAT EXCHANGER DIVISION • 385 MADISON AVENUE, NEW YORK 17, N. Y.

Atlanta • Boston • Chicago • Rock Island • Cincinnati • Detroit • Ft. Worth • Houston • Tucson • Salt Lake City • Minneapolis • Pittsburgh • Rochester • Albany • St. Louis • San Francisco • Wayne (Phila.) • Athens • Buenos Aires • Honolulu • London • Manila • Toronto • Paris • Rome • San Juan, P. R. • Mexico City

Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers.

✓for performance
✓for price
✓for delivery

OUTDOOR BREAKERS — 69 TO 230 kV



OUTDOOR CUBICLES — 14.4 TO 46 kV

BROWN BOVERI

indoor and outdoor

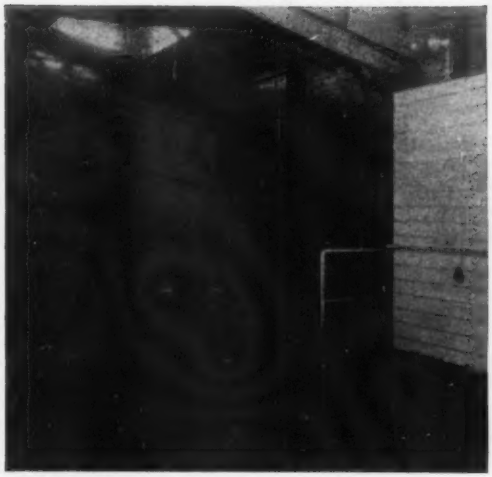
AIR BLAST BREAKERS

write for data

BROWN BOVERI CORP., 19 Rector Street, N. Y. 6
Please send me specifications and details on your
☐ indoor ☐ outdoor air blast breakers
for ____kV ____Amps.____kVA.
Name _____ Title _____
Company _____
Address _____

BROWN BOVERI

BROWN BOVERI CORP.
19 Rector St. • New York 6, N. Y.



BEFORE—Johnson-March system turned off at car dumper of a large midwest utility. Compare this unretouched photo with the one at the right.

AFTER—Note absence of dust when Johnson-March system is operating at this same dumper. These systems have proved themselves in many plants. We'll be glad to furnish names.

STOP COAL DUST

at 1/10 the usual cost!

If you have a dust problem—no matter how large or small—no matter where the dust occurs . . . car dumpers, hoppers, crushers, belt galleries, or coal pile—it can be controlled or eliminated with a Johnson-March liquid diffusion system. Installation is fast, simple, and inexpensive. There is no interference with normal plant operations.

No ducts, no fans and no cumbersome equipment are required. Johnson-March compounds added to water and a carefully engineered spray system do the work. The system is guaranteed effective, but its operation is simple. It costs far less than other types of dust handling systems—in most cases only 1/10 as much. And maintenance costs next to nothing!

Even though you may have a mechanical dust collecting system, it will pay you to investigate a Johnson-March system.

Without cost or obligation, why not have one of our engineers discuss your dust problems with you? Just drop us a line or mail the attached coupon.

THE JOHNSON-MARCH CORP.
1724 Chestnut St., Philadelphia 3, Pa.
Without cost or obligation, I would like to know more about the Johnson-March system of low-cost dust control. P-2

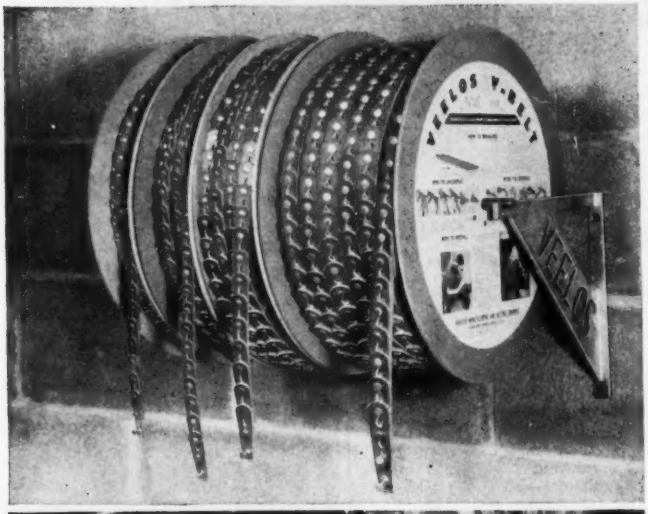
Name.....
Company.....
Address.....
City..... State.....

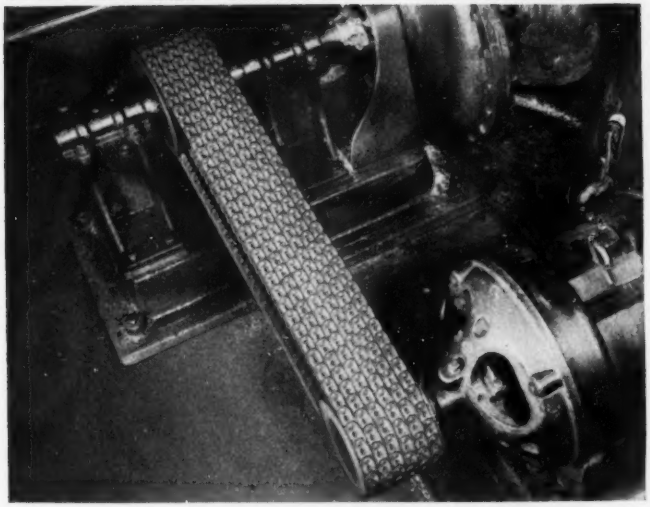
Johnson March

Specialists in Liquid Diffusion

1724 CHESTNUT STREET **Philadelphia 3, Pa.**

Veelos—*the Adjustable V-Belt*
Pays for Itself





In Inventory . . .

Veelos pays for itself by reducing required v-belt stocks. Just 4 reels of Veelos cover *every* v-belt need (up to 316 sizes) in the O, A, B and C widths. Stock only one reel for each width of belt you use—and *any length is readily available.*

In Maintenance . . .

Veelos pays for itself because it can be installed quickly and easily without dismantling outboard bearings or moving motor. Individual belts can be adjusted by simply removing or adding links.

In Operating Efficiency . . .

Veelos pays for itself because uniform tension can be maintained on all belts to provide vibrationless, full power delivery. Simple adjustment of each belt means that *matched sets stay matched.*

Write for your copy of the Veelos Data Book. It gives the complete story on why *Veelos pays for itself.*

MANHEIM MANUFACTURING & BELTING COMPANY
Manheim, Pennsylvania

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Made in all widths in three types; regular, oil-proof and static conducting. Also double V in A and B. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. Veelos is known as VEELINK outside the United States.

VEELOS
THE LINK
V-BELT

A pressure gauge on a boiler or tank may seem small and unimportant, but have you ever stopped to think what a big part of your plant's efficiency and safety rests squarely on the verdict of the pressure gauge?

Actually it's just about the biggest thing on the boiler or any other pressure equipment. The maximum working pressure of any important equipment was tested by a pressure gauge: if the gauge was wrong the test was wrong. In service, the pressure gauge guides operation: if the gauge is wrong efficiency suffers and safety is imperiled.

Fortunately, manufacturers of quality equipment realize the danger of placing good equipment at the mercy of poor gauges. That is why you find Marsh gauges on the leading makes of boilers, compressors, pumps, hydraulic equipment and food processing equipment. Look around your plant and you will see how true this is. Most significant of all you will find that Marsh Gauges are used by the leading manufacturers of controlling equipment — the manufacturers who know instruments best.

Always remember that you can't see the condition; you can only see the indication of it shown by a pressure gauge. For such a vital function only the best is good enough — and that means MARSH.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation* **DEPT. F, SKOKIE, ILL.**
Export Dept., 155 E. 44th St., New York, N. Y.

"THE STANDARD OF ACCURACY"

MARSH GAUGES

"For high dust collection efficiency CONSIDER THESE FACTS!"

95% to 99% REMOVAL

Your specific needs determine the exact percentage of fly ash removed by a Research Corporation Cottrell Precipitator.

LOW DRAFT LOSS

The pressure drop between inlet and outlet of the Cottrell is extremely low, averaging *only a few tenths of an inch of water.*

DURABILITY

Low velocities hold abrasion to a minimum.

ANY CAPACITY

Cottrell precipitators have been used successfully with both small boilers and the very large boilers developed in recent years.

OTHER APPLICATIONS

Cottrell precipitators have wide application in the recovery of other materials such as acid mist, blast furnace dust, sodium salts, fluid catalyst and valuable metals from smelters.

YOU GET all these important advantages PLUS Research Corporation's 38 years of experience in the field of electrical precipitation. Every Cottrell installation is individually engineered to do the most efficient job. For more facts about Research-installed Cottrells, send for Bulletin 500.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois

THESE TROUBLEMAKERS

IN PLANTS EQUIPPED with

CASH STANDARD *Streamlined* PRESSURE **REDUCING VALVES** TYPE 1000

THESE *Users* TELL WHY . . .

A Conditioning Corp. writes—

"Had a very critical job where it was important to HOLD CONSTANT PRESSURE TO VERY CLOSE TOLERANCES because we were using steam to reheat air to a set degree with allowed variation of less than one degree. Changed pressure reducing valves twice, then tried a CASH STANDARD Type '1000' and were able to accomplish the job."

A Maintenance Engineer says—

"I would be more than willing to recommend the performance of the CASH STANDARD Type '1000' Pressure Reducing Valve because we used the valve here UNDER ADVERSE CONDITIONS and found it PERFECT IN EVERY WAY—TROUBLE FREE and PRACTICALLY NO MAINTENANCE COSTS."

A Supt. of a Public Utility says—

"We operate a CASH STANDARD '1000' valve reducing steam pressure from 400 to 175 lbs. on our low pressure steam turbines' condenser air ejectors which is an important function and it has done the job WITHOUT FAILURE TO DATE."

A Tobacco Co. writes—

"We use only one '1000' valve in this department. It is used on the steam line to our Castle Autoclave (tough service). Our experience has been CONTINUOUS SMOOTH OPERATION for several years."

An Instrument Co. writes—

"Control of gasoline pressure on flo range of 5-4000 p. p. h. at 17½ psi. CONSTANT PRESSURE CONTROL over full range within 5%. This was on production test stands used for checking solid fuel injection on aircraft motors."

WRITE FOR BULLETIN 962

Note the benefits users say they get from their CASH STANDARD Type '1000' Pressure Reducing Valves.

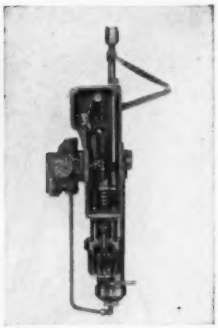
Check the benefits with this list

1. **Maximum capacity when needed most.**
2. **Accurate pressure control under toughest working conditions.**
3. **Trouble-free service.**
4. **Smooth operation.**
5. **Tight closure.**
6. **Speedier production results.**
7. **Elimination of failures.**
8. **Cost-saving operation.**
9. **No spoilage.**
10. **Practically zero in maintenance.**

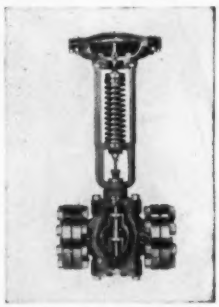
CASH STANDARD CONTROLS . . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES
Send for them



Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.



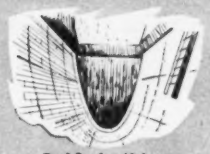
Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.

Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

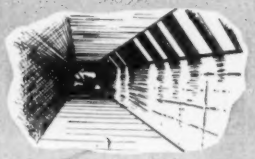
WHERE TO USE LUMNITE IN POWER PLANTS

Steel Stack Linings

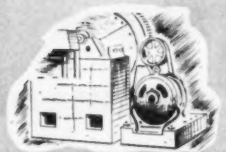
Ash Pit and Cinder Catcher Linings



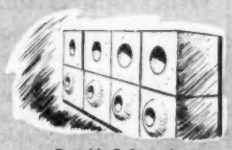
Coal Bunker Linings



Flue and Dust Linings



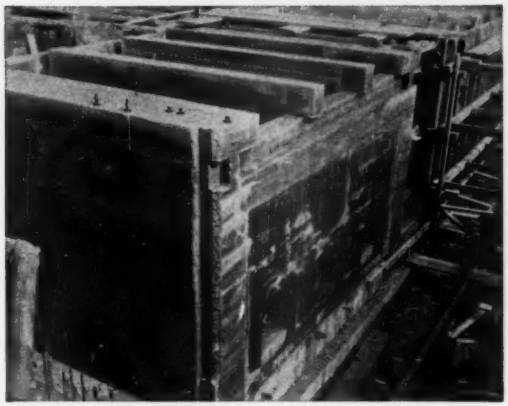
Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

BUILD AN ASH PIT ...THEN FORGET IT



Refractory Concrete Ash Pits resist heat, wear and corrosion

Ash pits and boiler foundations can be maintenance headaches—but they aren't when they are built with Lumnite* refractory concrete.

Monolithic refractory concrete ash pits are self-lined, easy and economical to install. Smooth refractory concrete surfaces replace joints and small units that can work loose. They resist soaking heat and sudden thermal shock from hot ashes. No other refractory lining is required even when temperatures reach 2600°F.

Refractory concrete made with Lumnite calcium-aluminate cement reaches high structural strength overnight, and ash pits, such as the one shown above, can also serve as boiler foundations.

In addition to the usual power-plant uses at left, refractory concrete has a multitude of power-plant uses—such as door linings, boiler baffles and many repairs that are ready for service in 24 hours or less.

Prepared castable refractory mixes which require only the addition of water are available. These packaged mixes contain Lumnite and selected aggregates to suit any requirement. Why not keep a supply of Lumnite or your favorite brand of castable on hand ready for rapid repairs? Get them from your refractory dealer. For more information and literature write to: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N.Y.

"Lumnite" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

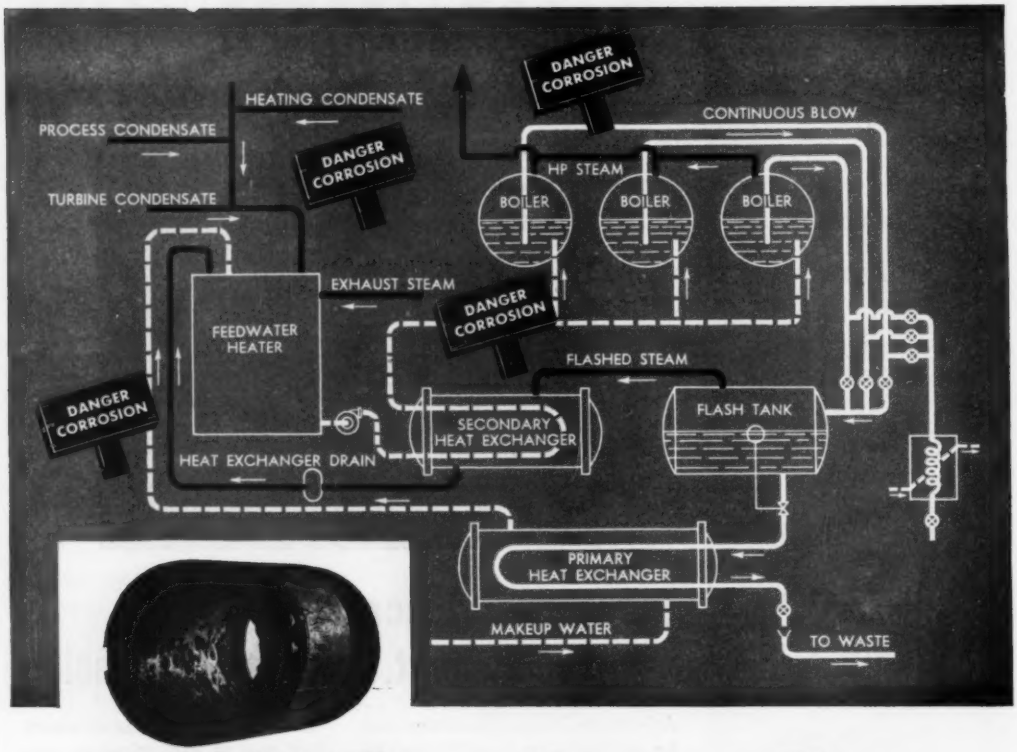
P-L-48

ATLAS® LUMNITE for INDUSTRIAL CONCRETES

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*



AVOID These Danger Signs with BIRD-ARCHER Amine Treatment

CORRODED condensate return lines lead to expensive pipe replacement and maintenance. As an added annoyance, the solid products of corrosion often plug return lines and fill traps. You can steer clear of these troubles by using the *effective, economical* Bird-Archer Amine Treatment.

HERE'S THE WAY THIS B-A TREATMENT WORKS

Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself.

HERE'S HOW THIS B-A TREATMENT SAVES MONEY

Raising the pH value of the condensate severely decreases maintenance costs by eliminating corrosion. These savings may more than offset the amount of treatment required to provide protection for your equipment.

NEW BULLETIN gives full details on the Bird-Archer Amine Treatment. . . . contains case histories that prove its successful application in many plants. *Write for your copy today.*

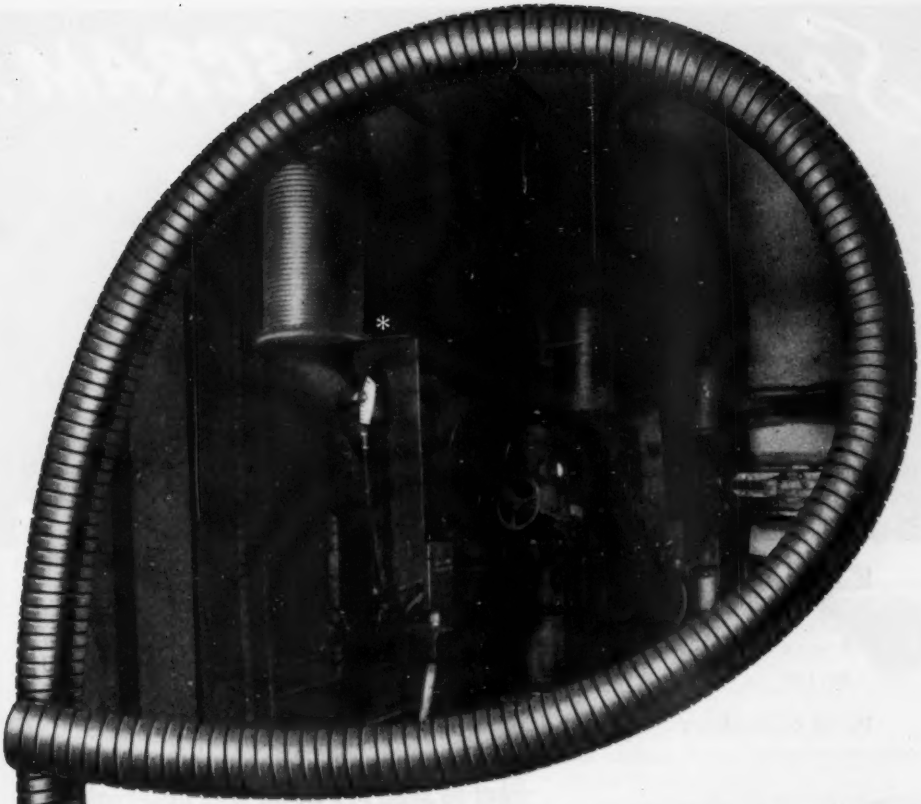
BA-154

WHAT AMINES ARE

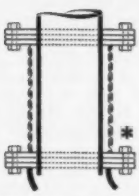
Amines are members of a class of chemical compounds in which one or more hydrogen atoms of the ammonia molecule are substituted by an organic group. Some of the simpler types are soluble and volatilize from boiler waters. The alkalinity of the amines is an inherent property and does not result from decomposition. *No free ammonia is released.* In the concentrations necessary for protection of condensate systems, amines are harmless to non-ferrous metals, non-toxic and are completely stable at temperatures approximating 675F.

BIRD-ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 4337 NORTH AMERICAN ST., PHILADELPHIA 40, PA.
NEW YORK • CHICAGO
IN CANADA: The Bird-Archer Co., Limited, 503 McGill Building, Montreal
IN MEXICO: Calderas y Accesorios, S. A., Amsterdam 291, Mexico, D. F.



HELPS "PIPE DANCE" IN BOILER OPERATION



(Cross-sectional view, showing Penflex tubing encasement on steel feed pipes from hopper.)

PENFLEX TUBING ABSORBS THERMAL EXPANSION

When a large public utility power plant fed powdered coal into burners of high-pressure steam boilers, thermal expansion moved steel feed tubes around, showering coal dust over equipment.

Penflex tubing was recommended as an outer protective encasement for the rigid steel tube that comes down from the hopper. Lengths of 20" & 24" I. D. interlocking, galvanized steel tubing were installed. Now the steel pipes from the hopper virtually "float" at one end when thermal expansion occurs. Penflex tubing forms a flexible seal between hopper and tube, assuring protected delivery of powdered fuel.

Let Penflex engineers help you on flexible tubing application problems. Penflex manufactures a complete line of four wall, interlocking and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from ⅛" I. D. and up . . . automatic barrel fillers, pneumatic rivet passers, accessories and fittings. Write for folder, "Flexineering," a valuable production aid.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7238 Powers Lane, Phila. 34, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

penflex

HEART OF INDUSTRY'S LIFE LINES

Copyright 1951 Penna. Flexible Metallic Tubing Co., Inc.

Sam, you better SCRAM!

No. 150

No. 157

Pump controllers

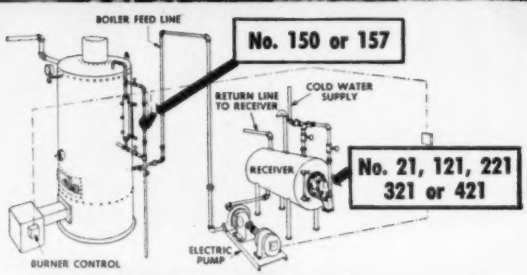
Highly perfected and proved in thousands of installations, the McDonnell No. 150 is the pump control for boilers with steam pressures up to 150 lbs. Convenient terminals provide circuits for pump motor (or starter), for low water cut-off of burner, and, when desired, for low water alarm. No. 157 (at right) is the same dependable control with integral water column which greatly cuts cost of installation under many conditions.

No. 21

No. 421

Receiver tank make-up feeders

To provide make-up water when insufficient condensate is returned to the tank, dependable McDonnell make-up feeders are available. Simplest form when adaptable is the No. 21 series (at left) which is installed right in receiver tank and feeds water directly. Four flange shapes and sizes are provided in this series (Nos. 21-121-221-321) to fit openings in most tanks. The No. 421 (at right) takes care of conditions where installation with equalizing piping is necessary. These quality feeders seat drip-tight against high water pressures.



—but no need to SCRAM with dependable boiler water level control

A steam boiler without automatic boiler water level control is strictly a "Sam-you-better-scram" deal. But there's no need to scram when the job of safeguarding the boiler is taken over by the simple hook-up diagramed above.

It will pay you to study this diagram for a moment and note how the water level (the feed pump) is controlled from the water level itself by a McDonnell No. 150 or 157 pump control. This modern method holds the water level within the close limits that steps up efficiency . . . pays for the control.

An extra switch on the control provides circuits for low water fuel cut-off and low water alarm if a fuse should blow in the feed-pump circuit. The McDonnell make-up feeder on the receiver tank maintains a minimum level in the receiver tank at all times.

Note the facts opposite about the dependable McDonnell equipment that will give you this protection and increased efficiency. Ask for data sheets covering every detail of the simple installation and wiring.

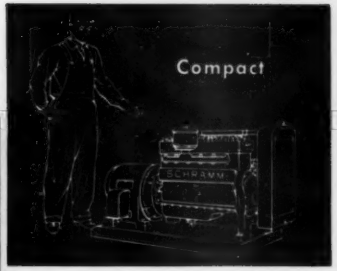
McDONNELL & MILLER, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.

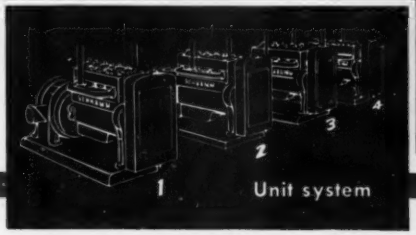
Doing One Thing Well

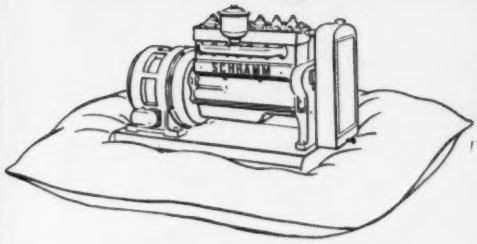
McDONNELL

Boiler Water Level Controls

Your Jobber Stocks Them

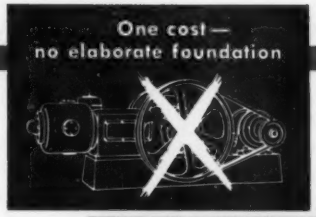


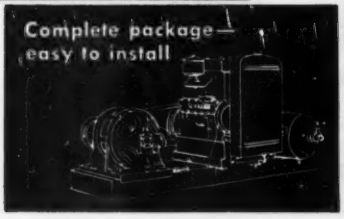




SCHRAMM

"VIBRATIONLESS" COMPRESSORS





VIBRATIONLESS

one of the many features of SCHRAMM AIR COMPRESSORS

. . . that make them ideal for INDUSTRIAL APPLICATIONS

SCHRAMM stationary air compressors are the only stationary compressors so free from vibration that they can be operated without an elaborate foundation by simply grouting and bolting to the floor.

Perfect balance of pistons and connection rods, the heavy rigid crankshaft supported on a substantial bearing between each cylinder, and vertical in-line construction, makes for vibrationless operation.

This feature you will find of value when it comes to smooth running, 24 hour heavy duty service, in all sizes ranging from ⅓ to 100 h.p.

Feature for feature, Schramm offers more. Get all the Schramm advantages by writing today for our bulletin C-50B.

SCHRAMM INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

SCHRAMM, INC.
WEST CHESTER, PA.

Please send Free Booklet C-50 B on installing Stationary Air Compressors.

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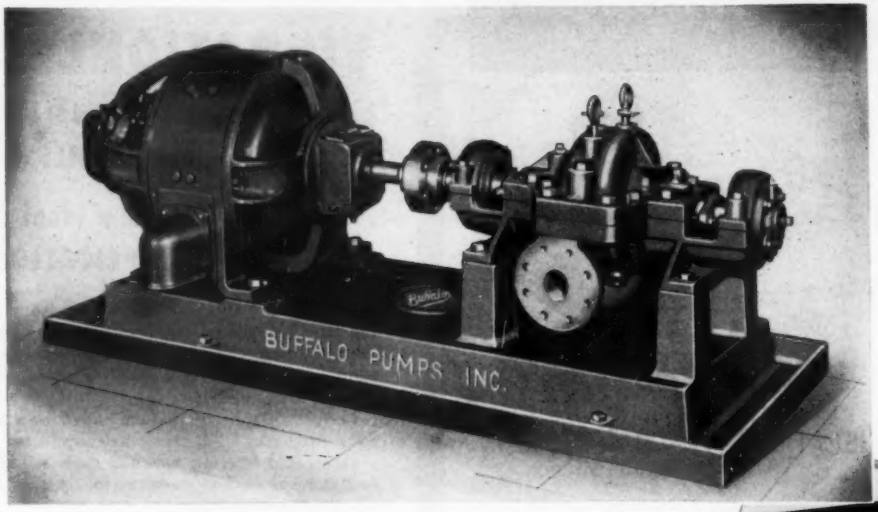
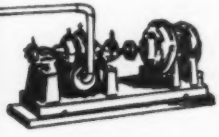
FOR HIGH PRESSURE CLEAR WATER PUMPING



"Buffalo" 2-STAGE AND 4-STAGE CLASS "RR" PUMPS

"Buffalo" Class "RR" Pumps are adequately built for the severe service of handling hot or chilled clear water at high heads, with exceptionally high efficiency. Practically no maintenance problem—modest power requirements—rugged endurance on the job—are what you get in "RR" Pumps. You will find all engineering details in BULLETIN 980-B. Write for your copy.

- Capacities Up to 900 gpm.
- For Heads Up to 1500'
- For Clear Water, Any Temperature



"Buffalo" PUMPS

BUFFALO PUMPS INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.
Branch Offices in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

HOW *INTRICATE* CAN POWER PIPING BE?

Some of the piping requirements received here at Power Piping would gladden the heart of a pretzel-bender. But whatever the contour, size, tolerance or specifications, our prefabricated jobs never fail to fit the installation like a glove.

Also we find a lot of satisfaction in the fact that Power Piping Division, over the years, has been called upon to furnish many intricate components for plants thousands of miles distant from our shops.

POWER PIPING DIVISION
OF BLAW-KNOX CONSTRUCTION COMPANY
1525 PENNSYLVANIA AVENUE
PITTSBURGH 12, PA.

are businessmen

COLD-BLOODED?

OF COURSE NOT! Literally, their normal body temperature is 98.6—same as laborers, engineers or any other group of people. And, figuratively, they're no more, or no less, cold-blooded—as a group.

We all know unreasonable generalizations can be dangerously false. Common sense and on-the-job experience show us the value of dealing specifically with ideas, problems—and *people*.

Let's not make the big—and costly—mistake, then, of generalizing on religious or racial groups. Adopt and *carry out* these common sense principles:

1. Accept—or reject—people on *their individual worth.*
2. Don't listen to or spread rumors against a race or a religion.
3. Speak up, wherever we are, *against* prejudice. Work for understanding.

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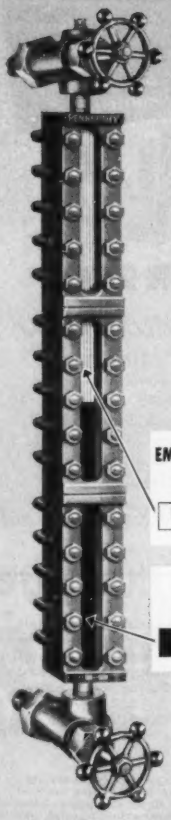
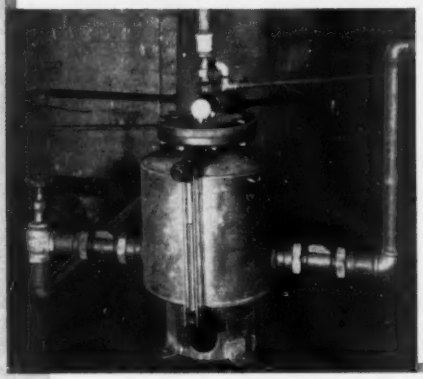
PENBERTHY PRODUCTS THAT improve PROCESS AND PLANT

PENBERTHY REFLEX LIQUID LEVEL GAGES



You can't misread the Penberthy Reflex Liquid Level Gage . . . *it prevents mistakes.* Due to a simple, invariable optical principle, the empty space always shows white . . . the liquid black. In addition to standard units, Penberthy Reflex Gages are fabricated to customers' specifications from special alloys to meet unusual corrosive, pressure and temperature conditions. Write for new Catalog No. 35.

PENBERTHY CYCLING JET PUMPS



Operated by air, gas, or steam pressure, pumps (without clogging) any liquid that will flow through pipes. Lifts fluid from lower level and discharges against pressure approximately equal to operating gas pressure. Operates automatically by ejector that exhausts the vessel . . . drawing in liquid . . . then gas pressure pushes it out. Ejector and its control valve not in contact with fluid pumped. Corrosion proofing easy. Write for Bulletin 5030.

PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Has no moving parts . . . needs no lubrication. Will not get out of order . . . wear is not appreciable. Reliable, noiseless, compact, convenient and initial cost is very low. Made in bronze, iron and wide variety of materials that successfully withstand corrosion, contamination and high temperatures. Special units developed to meet unusual conditions. Write for Catalog 34.

PENBERTHY *Explosion Proof* SUMP PUMPS

Motor and switch totally enclosed, this pump has Underwriters approval for Class I, Group D, and Class II, Groups E, F and G hazardous locations. These include gasoline, solvent vapors, metal dust, natural gas, carbon black, naphtha, alcohol, grain dust, acetone, lacquer, coal and coke dust, etc. Made of copper and bronze throughout, this pump is corrosion proof, durable, thoroughly dependable. Write for Bulletin 4929.

PENBERTHY ALSO MANUFACTURES A COMPLETE LINE OF LIQUID LEVEL GAGES IN BRONZE, IRON, STEEL AND ALLOYS

PENBERTHY INJECTOR COMPANY

DETROIT 2, MICHIGAN

Established 1886 — *Canadian Plant, Windsor, Ontario*

4290

LUBRICATION ECONOMY

"LUBRIPLATE improves Machine Operation"

The PACKAGE MACHINERY COMPANY of Springfield, Mass. writes "To assure the use of LUBRIPLATE Lubricants for re-lubrication of our machines in use, we place tags on them before shipment; thus the purchasers of these machines know the LUBRIPLATE product to use for each application."

1. LUBRIPLATE reduces friction and wear

2. LUBRIPLATE prevents rust and corrosion

3. LUBRIPLATE is economical to use

Write today for case histories of savings made through the use of LUBRIPLATE in your industry.

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Fiske Brothers Refining Co.
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The Different LUBRICANT!

DEALERS EVERYWHERE, consult your Classified Telephone Book

DESIGNED *for tomorrow*
Ultra-modern utility plant . . . an architectural masterpiece

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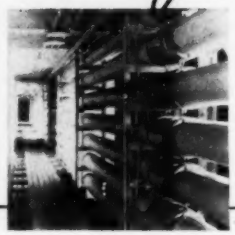

. . . Badger EXPANSION JOINTS . . . assure long, trouble-free life . . . an engineering masterpiece

Leading utilities are erecting ultra-modern power plants which are both *designed* and *engineered* for tomorrow. The structures represent the very latest trends in functional design . . . and the steam distribution systems must be engineered to perform with maximum efficiency. As you would expect, Badger Corrugated Packless Expansion Joints, constructed to the famous Directed-Flexing Self-Equalizing design are first choice with these forward-looking utilities.

* * * * * *

What's the reason you find Badger Expansion Joints specified on *important* jobs? Because engineers have learned from years of experience to put their faith in the performance of Badger Joints . . . performance that's a result of construction features like these:

- Directed-Flexing Self-Equalizing rings . . . progressively control the movement of the all-curve corrugations.
- Packless . . . pressure-tight single tube — requires no maintenance.
- Compact . . . approximately the size of flanged fitting.
- Special forming . . . no structure-weakening stresses.
- Controlled heat treating . . . assures long life.
- Wide range of traverse — pressure — temperature.

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.

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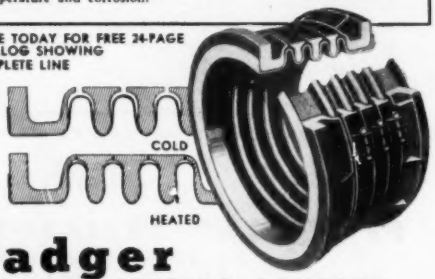
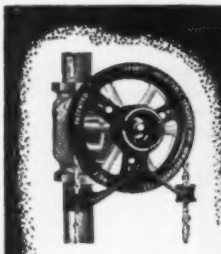


Badger
MANUFACTURING COMPANY
230 BENT STREET, CAMBRIDGE, MASS.



Babbitt
Adjustable SPROCKET RIM *with Chain Guide*

A range of 10 ADJUSTABLE sizes fits all valve wheels, with rising or non-rising stems, from 2 to 30 inches in diameter.

PREVENTS ACCIDENTS!
No more climbing to operate overhead valves.

PREVENTS WASTE!
Positive control, immediate response.

EASY CONTROL!
Easier than direct manual operation.

SAVES MONEY!
Avoids accidents, permits piping shortcuts, saves piping costs.

ADJUSTABLE . . . fits all valve wheels

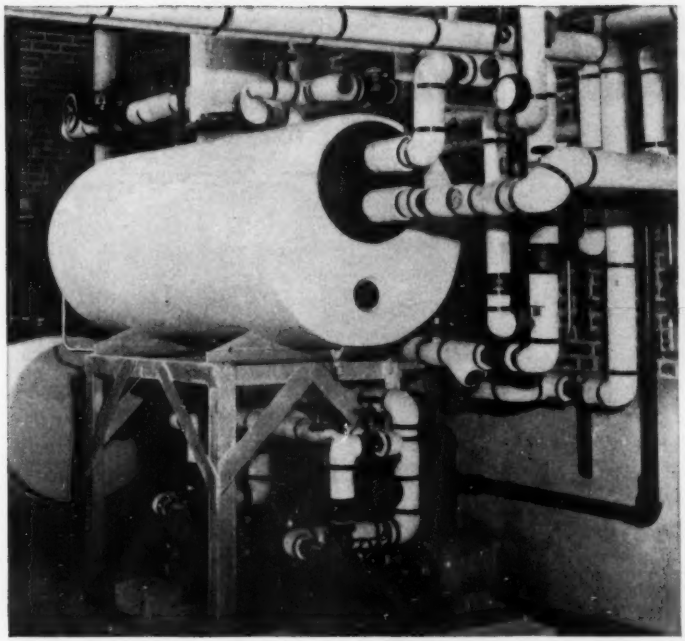
CUTS COSTS . . . simplifies pipe layouts

CUTS ACCIDENTS . . eliminates climbing

• Here's easy, convenient, instant control of overhead, out-of-reach valves—right from the floor! Four simple, quickly-assembled parts and the valve handwheel is ready to operate.

Distributors in principal cities, or send for Catalog Folder P-2 and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Massachusetts



SCHAUB
BOILER RETURN SYSTEMS

Model S6F Schaub Duplex Deaerator System at the Lawrence Hose Co. (formerly Anchor Thread Co.), Lawrenceville, N. J. Of the 200 H. P. total load, 50% is live steam usage, with 15% returns from a hot water storage heater and 35% returns from high pressure unit heaters.

Judge on Facts...Prove to Yourself —

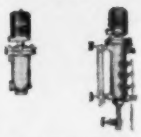
SCHAUB'S YOUR BUY!

Look at Schaub's three outstanding *exclusive features*. Check them point for point with your own experience. Then you'll realize how much more these *plus values* really mean...and why a Schaub System can actually give you more—in low-cost maintenance, improved operating economy . . . and enduring dependability for many years to come. In short, you can't afford to buy a boiler return system until you know the Schaub story ...then, you won't be satisfied with less.

Only* SCHAUB *Has This Exclusive Combination of Features . . .

No more periodic pump maintenance! Schaub Master-Bilt Pumps have new Fleximatic Mechanical seals and permanently lubricated ball bearings. No more water puddles. No more scored shafts. No pump packing or greasing to do—ever!

10-year receiver corrosion guarantee. Schaub engineers worked with leading chemical researchers to develop the Chromonoid lining. You're safe from costly premature replacements. No more rust-clogged systems.



Schaub Systems use only proven super-SAFE Magnetrol pump control and low-water cut off. No bellows to stiffen, no packing to bind, no tricky electrode circuits to fail. Magnetrol's tireless, friction-free magnetic force provides ultra-dependable switching action at all times. BOILER SAFETY KNOWS NO PRICE.

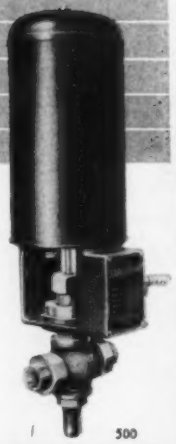
Schaub also builds Patented Heat-Reclaim and Spray-Type Deaerating Systems for exacting requirements from 10 to 1000 Boiler Horse Power. Write for new Schaub Catalog No. 55 which gives more information on all types of Schaub Systems.

FRED H. SCHAUB ENGINEERING COMPANY

2105 S. Marshall Boulevard • Chicago 23, Illinois

SARCOSTAT

THE *NEW* HYDRAULIC OPERATOR



Operated by direct thrust of a neoprene-sealed plunger actuated by oil pressure—no pilots, gears or multiplying levers.

Available for open-and-shut or two-step control from any two wire switch—pressure, temperature, liquid level, etc.

Moisture proof and suitable for control of steam, water or air. The valve operating mechanism is adaptable for use in positioning of levers or dampers.

Full information in Bulletin 1081.

500

SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
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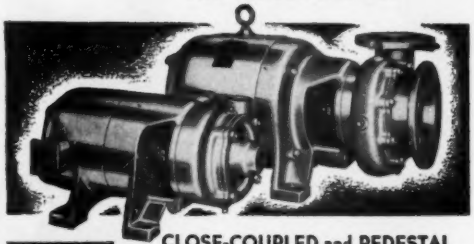
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

New... Different
THE "ALTA" LINE
FOR INDUSTRIAL USE



CLOSE-COUPLED and PEDESTAL GORMAN-RUPP PUMPS

This new line of centrifugal pumps combines all the advantages of exact hydraulic engineering with best mechanical design.

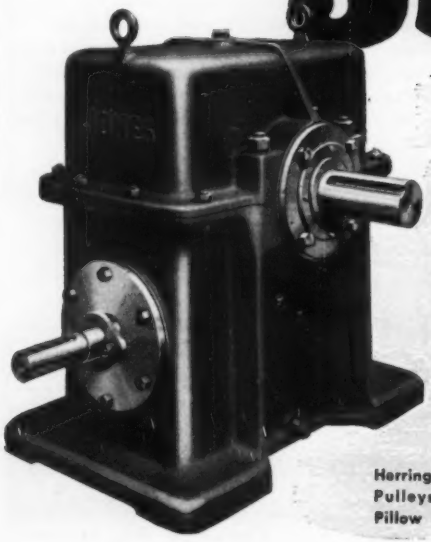
Alta Pumps are outstanding in efficiency serving a capacity-head range up to 1000 G.P.M. and 200 feet head with 14 sizes, 1 to 4 inches.

Open as well as enclosed type impeller for slurry and other services.

For detailed information ask for Bulletin 9-IP-11.

THE GORMAN-RUPP COMPANY
MANSFIELD, OHIO

Jones



WORM GEAR SPEED REDUCERS

A right angle unit built for heavy duty performance in any industry. The worm can be above or below the gear. Shafts are single or double extended for coupling connections or chain or gear drives.

They are built in ratios from 4 to 1 to 90 to 1 and in capacities from ¼ to 100 H.P.

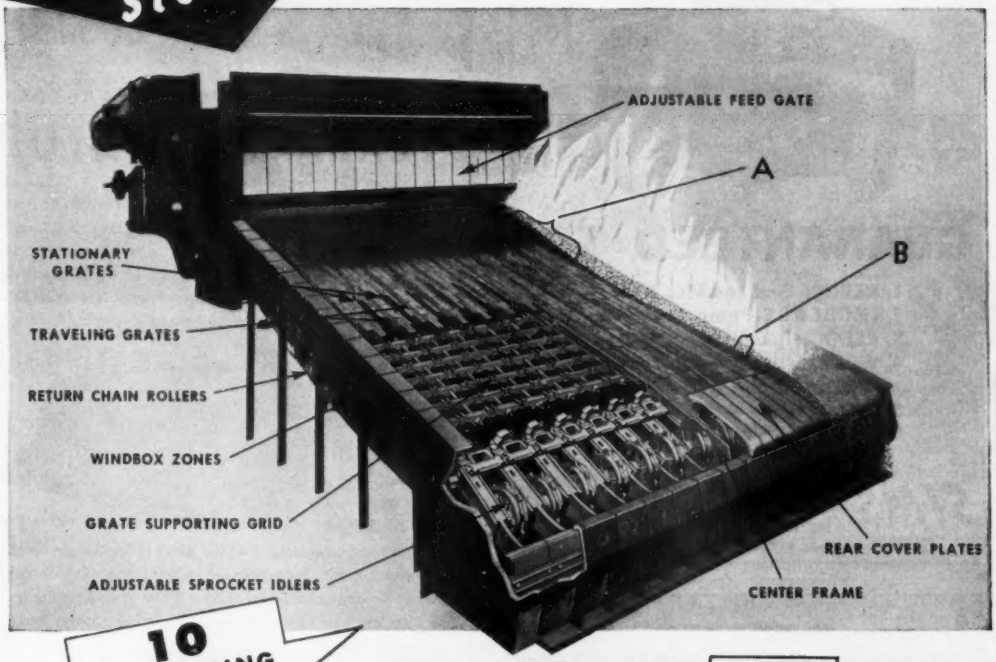
Bulletin No. 68 covers selection tables and dimensions.

W. A. JONES FOUNDRY & MACHINE CO.
4423 W. Roosevelt Rd., Chicago 24, Ill.

Since 1890 Jones *In the Service of Industry*

Herringbone — Worm — Spur — Gear Speed Reducers
Pulleys · Gears · V-Belt Sheaves · Anti-Friction
Pillow Blocks · Friction Clutches · Flexible Couplings

Only Stowe Stokers can give you this construction



10 OUTSTANDING ADVANTAGES . . . .

1. Even Depth of Fuel Bed
2. Uniform Air Distribution
3. Rapid Response to Fluctuating Loads
4. No Smoke or Fly Ash Nuisance
5. Unrestricted Coal Selection
6. Simplified and Less Costly Furnace Construction
7. Low Ash Pit Losses
8. High Combustion Efficiency
9. Low Upkeep and Maintenance
10. Reduced Boiler Room Force

GET THEM FOR YOUR PLANT

● Grates consist of alternate travelling and stationary members. The stationaries oppose the forwarding action of the travelling sections, and subject the entire fuel bed to a shearing, retarding effect that keeps the fuel bed porous and compressed lightly against the incoming coal. The clean radiant fuel bed burns closer and closer together as the combustibles and volatiles are burned out — preventing the formation of cracks, fissures and bare spots—and moves across the furnace slower and slower at practically even depth. Burns any bituminous coal. Ten outstanding features. Long list of outstandingly successful installations. Send for free booklet "What They Do and Where They Are Doing It". Don't delay. Send the coupon today.

Stowe Stokers

THE JOHNSTON & JENNINGS COMPANY
Division of PETTIBONE MULLIKEN CORP.
6917 Bessemer Avenue **Cleveland 27, Ohio**

Without obligation, please send your new booklet describing Stowe Stokers.

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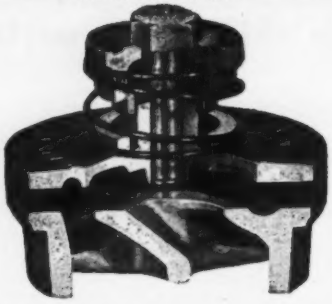
SIMS INCLINED PORT ROTATING PUMP VALVES



GUARANTEED TO:

1. REDUCE Seat and Disc Wear.
2. INCREASE Pump Capacity.
3. REDUCE Maintenance Costs.
4. WORK Efficiently in Light or Heavy Liquids.

Sims Valves are available for all reciprocating pumps.

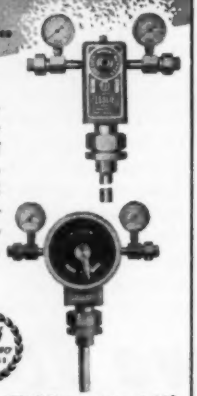
Write for Catalog V-111

SIMS PUMP VALVE CO., INC.

145 Hudson Street, New York 13, N. Y.
Houston Office: M & M Building, Houston, Texas

Reduce Water Bills and Maintenance Costs with the New LESLIE THERMOSTAT

Especially designed for cooling water service with greatly increased throttling range



It is a recognized fact that water cooled equipment, performs better and requires less maintenance if cooling water temperature is accurately maintained. New LESLIE Thermostat and Diaphragm Regulating Valve make an ideal Temperature Controller for this service.

Features

THROTTLING RANGE
BI-METALLIC ELEMENT
SIMPLE
RUGGED, RELIABLE

50th Anniversary 1900–1950

LESLIE Thermostats with 32° —400° F adjustable range and with calibrated dial.

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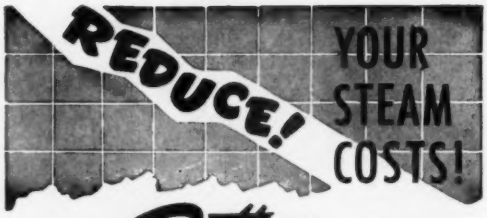
ESTABLISHED 1901 LESLIE CO.

235 Grant Ave., Lyndhurst, New Jersey

PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
FLOATLESS LEVEL CONTROLS • PUMP GOVERNORS
TEMPERATURE REGULATORS • SELF CLEANING STRAINERS
AIR HORNS • STEAM WHISTLES

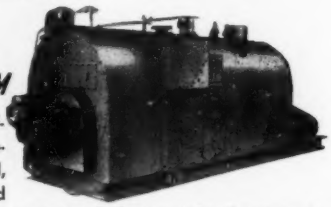


WITH A *Dutton* "PACKAGED"

STEAM GENERATOR

Dutton Steam Generators are QUALITY PRODUCTS, incorporating exclusive features of LONG LIFE, LOW OPERATING AND MAINTENANCE COST, MAXIMUM EFFICIENCY and SAFETY that only 71 years experience in boiler making can produce. Dutton Automatic "Packaged" Steam Generators are completely assembled — no special foundation or expensive chimney are needed.

Dutton EconoTHERM



Completely self-contained, automatically operated, 3-pass modified Scotch Internal Furnace type which gives twice the power in half the usual space. Features such as the Dutton Off-Center Firing and Rotary Combustion assure faster steam and more steam with less fuel consumption and greater safety. Burns gas or oil.

Dutton EconoMIST

A highly efficient horizontal return tube type, assembled in portable casing and ready for firing on arrival. Dutton improved shell design and double size full length, high bricked firebox, give faster steaming and longer steam carry-over with less fuel consumption. Burns oil, gas or coal with high efficiency — easily converted from one fuel to another. Available as a package unit with firing equipment, controls and mechanical draft with short stack.

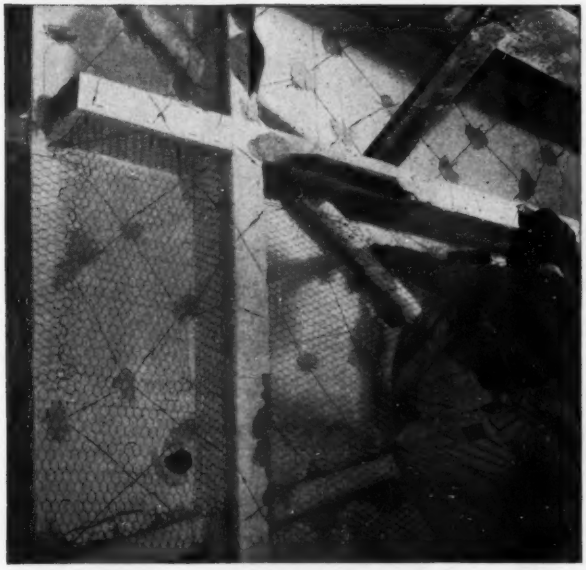
Let us help select the best type for you.

Write for catalog P-651 on "Packaged" STEAM GENERATORS.

Dutton BOILER DIVISION
HAPMAN-DUTTON COMPANY
KALAMAZOO • MICHIGAN
Boiler Makers Since 1880

Keeping Pace With Modern Boiler Design...

One Material Insulates The Entire Job–Better



New boiler installation by Babcock & Wilcox Company, an extension of Toledo Edison Company's Acme Plant, has a rated steam output of 650,000 lb. per hr. at 1500 psi. pressure and 1000°F. temperature. The new boiler is the largest in northwestern Ohio.

Kaylo Heat Insulation—the first basic advancement in the insulating industry in many years—is a hydrous calcium silicate. This remarkable inorganic material (not glass) provides a combination of far-reaching advantages.

With its wide effective temperature range—up to 1200°F.—Kaylo Heat Insulation eliminates the need for combination coverings in nearly all operating conditions. It retains its efficiency and dimensional stability in long service.

Kaylo Heat Insulation is insoluble in water. Its high strength practically eliminates spoilage both in transit and in application. Workmen can walk on insulated equipment without breakage. Yet along with its high strength Kaylo Heat Insulation is light in weight, making it easy to handle and apply.

For complete details on Kaylo Heat Insulation, write Dept. N-192, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO HEAT INSULATING BLOCK is made in all standard sizes, up to 18" wide and in thicknesses from 1" to 6". Where necessary, on special order, the block can be shiplapped for broken joint, single-layer application in thicknesses of 3" or greater.

KAYLO PIPE INSULATION is made to Simplified Dimensional Standards of thicknesses and diameters for snug nesting, when needed. Coverings are sectional for tube and pipe sizes ¼" to 12"; tri-segmental up to 23"; quad-segmental up to 41"; K-segmental (18" wide segments) up to 72" in diameter.

KAYLO® ... *first in calcium silicate*

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Super ADACHROME-CAST for "GUNITING"

Use SUPER ADACHROME-CAST to gunite your stud tube water walls,—Fine-grained to penetrate the small apertures between studs,—packs to a dense mass when shot. One user reports SUPER ADACHROME-CAST lasted twice as long and took but one-third the time to apply as compared with a plastic chrome ore installation.

Excellent for coating brickwork when free of slag.

Ask for detailed Bulletin on SUPER ADACHROME-CAST.

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In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

- INDISPENSABLE . . . for conveying fluids through movable pipe lines or equipment in motion! Complete 360° movement—with no flow restriction. Four styles for standard pipe sizes ¼" to 3".
- ECONOMICAL . . . simple in design, Flexo Joints contain no springs, no small or loose parts—assure long wear, extremely low maintenance cost.

Write for literature on FLEXO JOINT uses.

FLEXO SUPPLY CO., Inc.

4655 PAGE BLVD. ST. LOUIS 13, MO.
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This boiler is important to you...

For the critical, uncertain period ahead comes the modern MUND boiler with design features that promise continuous, automatic performance. Here's assurance of uniform power and trouble-free operation NOW when you need it most. You can always depend on Mund Boilers.

Write for complete information

MUND Boilers, Inc.

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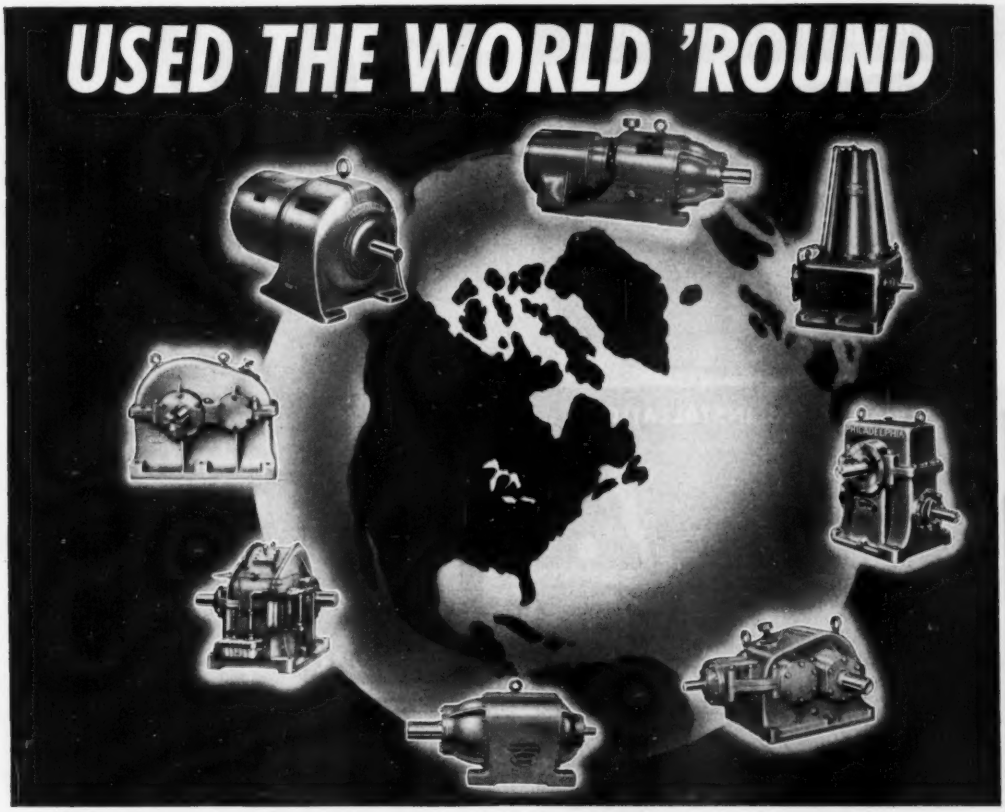
USED THE WORLD 'ROUND



...for speed reduction and cost reduction

PHILADELPHIA
SPEED REDUCERS

Shown above (clockwise) starting at North Pole: Horizontal MotoReduceR, Steeple type vertical Worm Reducer, Horizontal Worm Reducer, Spiral-Bevel Reducer, Planetary Reducer, Double Helical Speed Increaser, Herringbone Reducer, GearMotoR.

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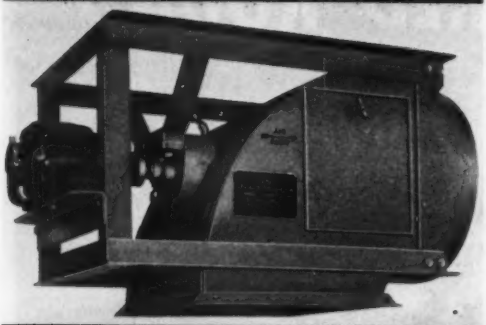
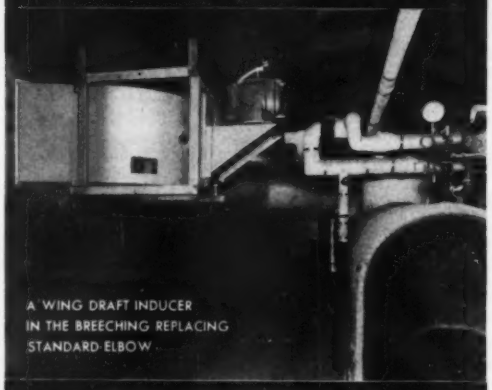


THIS IS A TYPICAL INSTALLATION



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Reprints of the Power Handbook (Parts I and II) will be made available about the middle of July. It will contain 64 fact-filled pages, and the price of single copies is $1.00, slightly less for quantities of 100 and over.

We will be happy to reserve your copies if you order now. We are sorry that we had to disappoint the many engineers who wanted reprints of Part I, alone, which are not available.

Send your order for the complete Power Handbook to: Power, Reader Service Dept., 330 West 42nd St., New York 18, N. Y.

BIDDLE
Instrument News

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NUMBER 4 OF A SERIES

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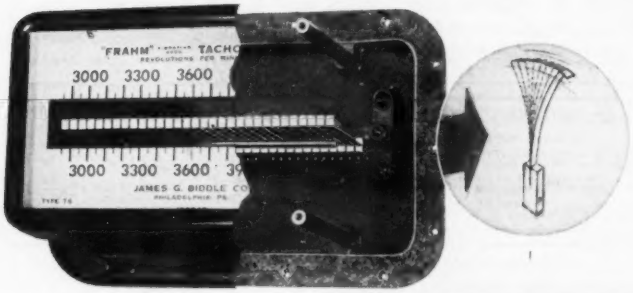

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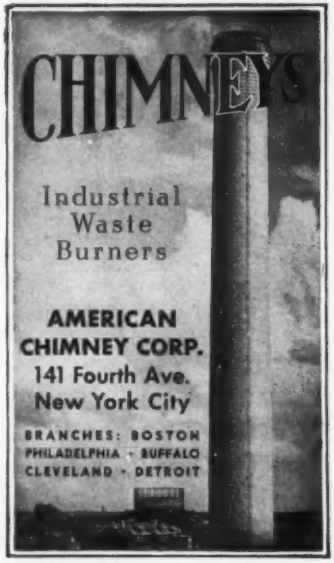

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We Mobilize for Freedom

WHY Controls are Necessary

One of the encouraging characteristics of the American people is their dislike for government controls. This augurs well for the future of their economic and political freedom.

But for the next few years we must not only tolerate but also help to make effective a whole battery of emergency government controls over our economic life. If we fail to do this now the future of that freedom we cherish will be imperilled. It is the purpose of this editorial—the third in a special series—to explain in simple terms why this is so.

After our military victory in World War II, we rushed through a demobilization which cut our military strength to about one-tenth of its wartime peak. Our allies did much the same thing. But the Russians maintained much of their wartime military strength and built up that of their satellites. With prodigious speed we switched from military to civilian production and went on to enjoy a rousing postwar boom—the greatest in our history.

This boom was in vigorous progress when, on June 25 last year, the Russian-sponsored North Korean army attacked South Korea. Our industrial production was rolling along at almost twice its prewar level. We had labor shortages in many key industrial areas. Under the impact of heavy buying all along the line, prices were climbing.

When the North Koreans smashed into South Korea they smashed into our national consciousness this fact: if we want a fair chance to save our national freedom from destruction by Communist aggression, we must race to restore some of the military power we had so speedily written off after World War II. And we must do it with our resources already very fully occupied with a boom in civilian business.

Program Small Compared to World War II

Compared with our military effort in World War II, the mobilization on which we are now embarked is small. At its peak, under present schedules, it will absorb no more than one-fifth of the total national production. During World War II we reached a point when nearly half of our total production went for war-making.

Moreover, our economy now is much bigger and stronger than it was in World War II. During the last decade there has been an increase of about 15 percent in our labor force. Our workers have had the training advantage of steady employment. The capacity of our industrial establishment is two-thirds again as great as it was ten years ago. Since the war no less than $70 billion has been spent to expand and modernize it.

Given time, the industrial giant we have created could pick up in its stride the added load of production for defense that now is con-

templated. But speed is of the very essence. There is little dissent from the proposition that if we are to stand off Russian aggression successfully we have, at the outside, two years in which to get ready.

Controls Needed to Prevent Chaos

These two facts – (1) the necessity for speed in our rearmament program and (2) an economy already stretched taut by a record civilian boom—create the general necessity for government controls. If we simply pile the billions of added defense expenditures authorized since last June on top of the civilian boom, and let it go at that, two destructive developments would follow. There would be a scramble for scarce materials, notably metals, which would create chaos in those markets. And prices would go through the roof.

Our situation during this mobilization is radically different from what it was when we rushed to get ready for World War II. Then we started with an economy that was coming out of a long depression. There was plenty of slack. Even in mid-1941 we still had over 6 million unemployed. Thus it was possible for us to expand war production greatly and also increase civilian living standards before the limits of our productive capacity made extensive controls necessary. But as we begin this new mobilization we find our economy already operating virtually at capacity. This fact is of key importance in understanding why this relatively small defense program so quickly requires the imposition of controls.

The selection and administration of controls thus far has been badly bungled. The threat of price controls, for example, was broadcast so vigorously and for so long that our people were virtually asked to raise prices and thereby do much to defeat the controls. Adequate taxation directed so as to attack inflation at the source and thus give direct price control a chance to operate has not yet been provided.

Indeed, we could readily assemble a long and devastating catalog of the deficiencies of the government's control program. But that would not dispose of the necessity for controls – by priority, by allocation, and, as a stop-gap, by direct prescription of selling prices – if we are to carry out our mobilization successfully. That is the only means by which a clear right of way for defense production can be cut through the highways of trade and commerce now jammed with civilian boom business.

Hope In The Wilson Plan

Since he became Director of Mobilization, Charles E. Wilson has added a new element of order and hopefulness to the mobilization program. He has laid out a plan which, if we are spared all-out war, would do three things by 1953. First, it would produce the weapons needed by our army and our allies to meet an immediate threat. Second, it would create the capacity that would enable us to move at high speed into weapons production for all-out war – if necessary. Third, it would create the additional production capacity that would restore by that date our ability to resume the climb of the American civilian standard of living.

In technical and industrial terms the Wilson Plan seems to be feasible. If it is successfully carried out, we should be able to begin getting rid of controls rapidly by 1953. But to carry out the program successfully, it must now have vigorous support from everyone. That does not mean mere agreement that it is a good plan. It means that we must conform to the controls that are necessary to make the plan work. In developing this support, the business community is in position to exercise crucially important leadership.

As has often happened in our national history, we are confronted by a paradox. We must accept emergency controls for the time being to insure survival of the freedom that they infringe. But, as we do this, we may find some comfort in the reflection that while controls from Washington are hateful, controls from Moscow would be infinitely worse.

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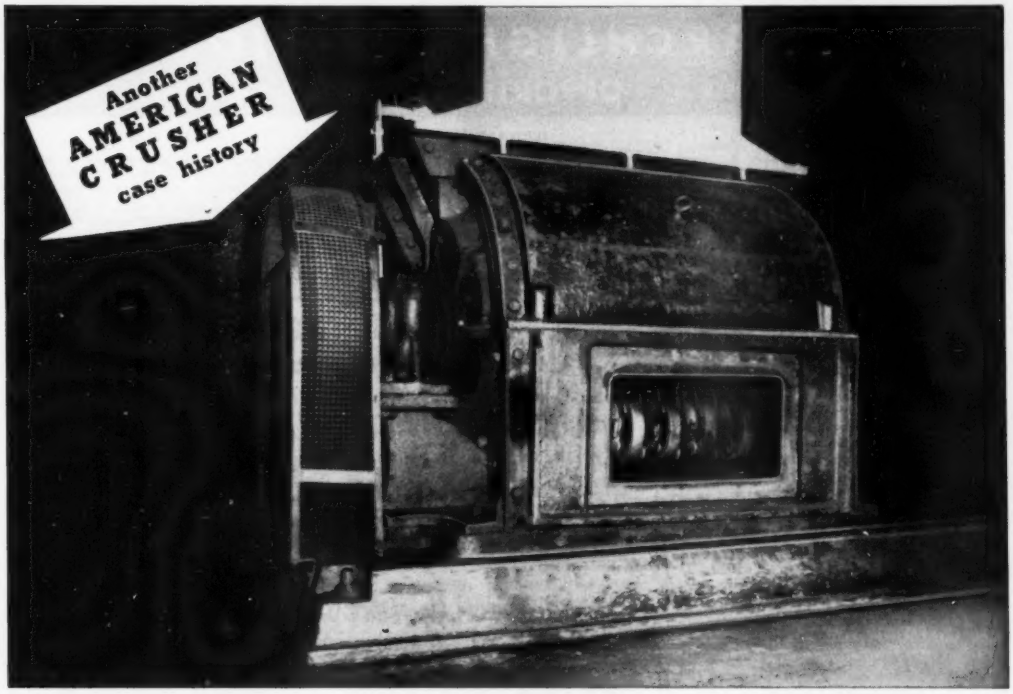

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(*Continued on opposite page*)

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FYR-FEEDER ENGINEERS
Division American Coal Burner Company
18-R EAST ERIE STREET, CHICAGO, ILL.

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT — PARTIAL LISTING

800/1600 AMPERE ARC WELDING MOTOR GENERATOR SETS

Each set consists of two generators and one motor, mounted on base. Each Generator: Northwestern Type K20DR, 800 ampere, 50 volts, 1750 RPM. Motor: 125 HP, Allis Chalmers, Type AR, 2200 volts, 3 phase, 60 cycle, 1750 RPM.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-2301
2	10	1140	410	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	830	440	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	15	690	440	West.	MW-316
1	20	880	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	350	220	Wagner	BR
2	25	730	440	Wagner	22VBB
1	30	865	440	West.	CW-646
1	30	350	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	400	F-M	HV-H16A
2	40	865	2200	Al.Ch.	ARY-223C
1	40	860	440	G.E.	MT-346
2	50	1150	440	G.E.	M-556
1	50	860	440	West.	HF-12A
1	50	570	440	G.E.	MT-552
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
1	200	495	2200	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
1	300	600	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡Intermittent rating. ***2 phase.
**New. †125 cycle.
†Also 440 or 550 volts. *Also 440 or 2300 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

Qn	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qn.	HP	Speed	Make	Type
10	3	850	Reliance	Y-23T
23	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-65
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	900	West.	SK-93
1	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20**	1440	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	BC-30
1	20**	1450	G.E.	CDM-38
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-13
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	G.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	HP	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-927
1	12½	230/340	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	100/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	600/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1200	Reliance,	T-4611
1	75	500/1500	Cr.Wh.	CCM
1	75	375/750	Cr.Wh.,	
3	100	225/900	G.E.	MPC-125M
6	100	400/1200	Al.Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
2	5	1750	440	L.A.	JA-254
9	5	1730	440	G.E.	K-254
4	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
23	5	1750	440	L.A.	PA-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
1	50	1760	440	L.A.	FX-445A
8	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335

OPEN TYPE MOTORS

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
2	25	900	220	G.E.	KT-512
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	1800	220	Howell	SCRB-356***
2	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1755	220	G.E.	FT-513
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60*	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
4	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-352
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
1	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡	G.E.	KT-5668
2	300	587	2200	West.	CS-704
1	500	1200	140	G.E.	KTP-567
1	700	1800	2300/ 4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts.
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

G. E. DYNAMOMETER

Cradle Type, with control and Dial Scale. (Write for Complete Specifications.)

Qn.	HP	DC Volts	RPM	Type
1	200	250	1200	C

MOTOR GENERATOR SETS

125 and 250 Volts D. C.

(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5	West.	1455	125	380/220§
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1750	250	220/440
15	West.	1450	125	220/440§
16	West.	1750	125	2200/440
25	G.E.	1200	125	220/440
30	Al.Ch.	1750	125	220/440
50	G.E.	1720	125	220/240†
75	G.E.*	1200	125	220/240

Note: 3KW, 5KW & 7.5KW, 250V Sets Available.
**New. *Synch. Motor Driven. §50 Cy. †25 Cy.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. CLEVELAND 14, OHIO

MOTOR GENERATORS

1—1000 KW G.E. Syn. 250 V. 720 RPM
2—300 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW WEST. Syn. 250 V. 1200 RPM
1—200 KW ELLIOTT Syn. 125/250 V. 1200
1—100 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
2—300 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
1—300 KW WEST. Syn. 250 V. 1200 RPM 6 Ph., 60 Cy. Transformers.
1—150 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
1—150 KW WEST. Syn. 250 V. 1200 RPM 6 Ph., 60 Cy. Transformers.

ARMATURES

1—500 KW G.E. 250 V. MPC Gen. 900 RPM
1—300 KW G.E. 600 V. HCC Coav. 1200 RPM

WALLACE E. KIRK COMPANY

502 Grant Bldg., Pittsburgh 19, Pa.

COMPRESSORS

VACUUM PUMPS
REBUILTS WITH NEW GUARANTEE
— AMERICAN —

SPECIAL
676CFM—INGERSOLL 15/9½x12xCB-2
877CFM—INGERSOLL 17/10½x14xCB-2

RENTAL
273 AIR COMPRESSORS AVAILABLE
RENTAL PURCHASE
GAS — DIESEL — ELECTRIC

AMERICAN AIR COMPRESSOR CORP.

Dell Ave., & 47th North Bergen, N. J.

JOHN H. BENSON ROY L. WILIMZIG

MOTORS!! PUMPS!!

5—250 HP, 1170 RPM, Allis-Chalmers, Splash-Proof, Frame 630—DSWW, 3/60/2300

1—250 HP, 900 RPM, GE, Slipring, 3/60/440

1—125 HP, 1800 RPM, F-M, Slipring, Frame R161D 3/60/2300, Control available

2—10"x8" Morris Slurry Pumps, No. 85, 1000 GPM, 110 ft. head 150 HP 700 RPM, with or without motors.

1—Northern Hydraulic 3000 PSI, 99 GPM, Size 5820, 580 RPM, NEW SURPLUS.

1—4" GOULDS 500 GPM, 1320' Hd. 3500 RPM, Fig. 3360, 250 HP.

1000 OTHER PUMPS IN STOCK!
PHONE, WRITE OR WIRE!

C & S MACHINERY CO.

1708 N. 8th St. St. Louis 6, Mo.

GA-4290

POWER PLANT BARGAINS

Boilers, water walls, stokers, turbo, steam and Diesel Electric units, transformers, air compressors and large motors.

Send your power problems and list of equipment available to:

BENJAMIN W. BISSELL, Reg. Engr.
521 K. of P. Bldg., Indianapolis 4, Ind.
Phone: Lincoln 4007

LIQUIDATION SALE — Modern Equipment

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE
1600	General Motors	16-278A	720	2
1600	Fairbanks Morse	38D O/P	720	2
1600	Hamilton	RB99-D.A.	700	2
900	General Motors	12-567 ATL	750	2
412/300	General Motors	6-71 (quads)	1200-2000	2
206/400	General Motors	6-71 (Twins)	1200-2000	2
215	Superior	VDM B	600	4

DIESEL GENERATOR SETS

DC	1200 KW	525V	750 RPM	General Motors	16-278A
	650 KW	240V	750 RPM	General Motors	12-567
	125 KW	120/240	600 RPM	Superior	VDMB
	100 KW	120/240	1200 RPM	General Motors	3-268A
	60 KW	120V	1200 RPM	Buda	909
AC	200 KW	3/60/450	1200 RPM	General Motors	6-268A
	100 KW	3/60/450	1200 RPM	General Motors	3-268A

3—75 KW, 1200 RPM, 3 phase, 60 cycles, 120-208 Volts synchronous generators, mfg. by Electric Machinery Mfg. Co. belt driven by 110 HP Cooper Bessemer diesels, type GAWD, size 10½x15, 327 RPM (new 1944)

TURBO-GENERATORS—D.C.

1—375 KW 180/240 V GE Shunt. 1200 non-cond.
5—300 KW 120 V Whse. Compd. 1200 cond.
1—300 KW 240 V GE Compd. 1200 cond.
5—150 KW 120 V Whse. Shunt. 1200 cond.
1— 60 KW 125 V 3600 RPM Elliott
12— 60 KW 120 V Whse. Stab. Sh. 1800 cond.
2— 25 KW 125 V 3600

MOTORS—DC

1500 HP 525 V DC 600 RPM W'hse.
1362 HP 415 V DC 1200 RPM Elliott
687 HP 375 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
322 HP 230 V DC 3050 HP W'hse
50 HP 230 V DC 525/1800 W'hse.
60 KW 125 V 1700 RPM

GENERATORS—DC

1200 KW 525 V 750 RPM All. Chalm.
1075 KW 375 V 750 RPM Elliott
700 KW 240 V 500/720 Elliott
540 KW 110/220/250 V. 1200 West.
65—Line Starters, G.E. type CR-5230-B-26, 115V DC, 9.5 amps, waterproof, cat. #11K2099.

AIR COMPRESSOR

2000 CFM at 90 psi, 3 stages, driven by 450 HP diesel mfr. Clark Bros.

HIGH PRESSURE AIR COMPRESSORS
CENTRIFUGES
EVAPORATORS
SOOT BLOWERS
WINCH TYPE MOTORS

MODERN TURBO GENERATORS AC

5—2000 KW 3 phase 60 cycle 3600 RPM 480/600/2400/4160V type ATB-2 Form HL driven by steam turbine, 410# steam pressure, exhaust 2½" Hg abs., 275 deg. F superheat. General Electric Company. (also 2900 at 1700 V)
2—250 KW G.E. type ATI 3/60/450 1200 RPM condensing.
2—200 KW Westinghse. 3/60/450 1200 RPM condensing (unused).
6—200 KW G.E. type ATB 3/60/450 1200 RPM cond. and non-cond.

GENERATORS—AC

5—2000 KW 3/60/480/600/2400/4160 3600 RPM type ATB-2 Form HL. Mfd. by G.E.

MOTORS—AC

4—6000 HP at 93-1/3 cycle 400 RPM or 3800 HP at 60 cycle 257 RPM—G.E.

Transformers Dry Type, 6- 10-KVA, 9- 15-KVA, 6- 20-KVA, 3- 25-KVA. Primary 450, secondary 117 Volt.

ICE PLANTS (New)

2—22 ton capacity, Freon 12, mfd. by Frick.
4—2 ton capacity, Freon, mfd. by York, model 2LA312.

BOILERS

2—Cyclotherm 3000 pounds steam per hour, 125# press.
1—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435#.
1—Cleaver Brooks, 2000 pounds steam per hour, model OB-5M, 100# press.

HEAT TREATING FURNACES

A large stock of heat treating furnaces by Rockwell, Westinghouse, Leeds & Northrup, American Electric Furnace Company, Heavy Duty Electric, Hayes, for annealing, carburizing, tempering, clean drawing, hardening, nitriding, reheating, and any heat treating purposes.

STEAM TURBINES

All New

1—110 HP 250# steam, 10# Exh. Press. 1200 RPM Sturtevant
10—56.5 HP, 300-475# steam, 10-15# Exh. Press 1225-1600 RPM, Sturtevant

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes	
2	8000	C.H.Wheeler	2	Brass	¾"
3	3300	Str. Wells	2	Alu-Brass	¾"
3	1050	Conseco	2	Cu Ni	¾"
23	400	All. Chalm.	2	Brass	¾"
2	300	Wheeler	2	Cu Ni	¾"
8	155	Conseco	2	Brass	¾"

AIR EJECTORS

1—Foster Wheeler for 3800 sq. ft. cond.
1—Ingersoll Rand 275# press., for 8250 sq. ft. condenser.

32—Diesel engines, G.M. Detroit model 6-71, 2 cycle, twin units, rated 206-400 HP at 1200-2000 RPM (per unit of two engines). Excelent condition.

AXIAL FLOW FANS

16,000 CFM 3" S.P. 3/60/440 Buffalo
35,000 CFM 1" S.P. 230V DC Wing

BLOWERS — AIR PUMP

5—Blowers, Roots Connersville, size 16x18, serial No. 14882, capacity 5000 CFM against 6 lb. sq. in. ga. pressure or 3450 CFM when creating 20" Hg vacuum.
1—Air Pump, Ingersoll Rand, type FS548, 5500 CFM, discharge press. 24.22 abs., intake press. 20.61 abs., with 125 HP motor 3/60/2300.
1—Air Pump, Ingersoll Rand, type FS548, 6600 CFM, discharge press. 20.86 abs., intake press. 17.10 abs., with 150 HP motor 3/60/2300.
1—Blower, Buffalo, size 60, type R, with 150 HP motor 3/60/2200.
1—Blower, Roots Connersville. Size 20x45.
1—Blower, Wilbraham-Green, size 24½x49.

WIRE ROPE SLINGS

Dia. from ⅝" to 2½"
Length from 10 ft. to 150 ft.

HOISTS

15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines. [NEW].
1—50,000# pull at 3-6 FPM, single drum, light line pull 2000# pull at 300 FPM, with Continental gasoline engine and torque converter.

BOILER FEED PUMPS
FIRE, IRRIGATION AND GENERAL SERVICE PUMPS
OXYGEN PRODUCING PLANTS
WELDING ELECTRODES
REDUCTION GEARS

HUGO NEU CORPORATION

31 Nassau Street New York 5, N. Y.

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WAGNER
CERTIFIED REBUILT

ELECTRIC MOTORS & GENERATORS
Backed by 45 Years — *of Quality & Service*

M-G SETS

KW	Mfr	Input V	Output V
500	Whse.*	2200/440 AC	250 DC
300	G.E.*	440 AC	275 DC
200	Whse*	2300 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Gen. Elec.*	2300/440 AC	600 DC
150	Cr. Wh.*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Allis Ch.* (2)	2200/440 AC	60 DC
100	Whse.	230 DC	220 AC
100	Whse.	220/440 AC	230 DC
100	Gen. Elec.	220/440 AC	125 DC
100	Gen. Elec.	220/440 AC	250 DC
75	Gen. Elec. (2)	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
65	Whse.	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (3)	220/440 AC	125/250 DC
50	Gen. Elec.	220/440 AC	250 DC
45	Cr. Wh. b.b.	220/440 AC	125 DC
40	Whse. (2)	220/440 AC	125 DC
40	G.E.	220/440 AC	250 DC
35	G.E.	220/440 AC	40 DC
25	Gen. Elec.	220/440 AC	250 DC
25	G.E. b.b.	220/440 AC	125 DC

*Syn. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
150	Cr. Wh. TEFC	8SH	230	880
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	CD125	230	850
75	Whse. (2)	SK163	230	850
75	Gen. Elec.	CD103	230	1750
75	Gen. Elec.	RC	230	1000
75	Northw'n	E29	230	1750
75	Cr. Wh. b.b.	CMC-HH	230	1150
60	Cr. Wh.	50H	230	700
60	Reliance b.b.	6517T	230	750
50	Cr. Wheeler	CMC	230	1750
50	Gen. Elec.	R.C. 14	230	1050
40/60	Whse.	SK160	230	500/1000
40	Gen. Elec.	RC-32	230	1150
40	Cr. Wheeler	EH	230	1750
40	Whse.	SK110L	230	1750
40	Whse (2)	SK139	230	950
35/50	Gen. Elec.	CD124	230	575/1150
30	Whse.	SK110L	230	1150
25/30	Cr. Wh. b.b.	FH	230	575/1725
25	Whse.	SK159	230	900/1750
25	G.E. b.b. (2)	CD93	230	1150
25	G.E. b.b. New	CDM93	115	1150

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.
- SPEED REDUCERS.

D. C. GENERATORS

HP	Mfr	Type	Volts	Speed
300	Gen. Elec. 1brg.	DMC	275	720
150	Cr. Wh. b.b.	8SH	230	1150
105	Century b.b.	1500 amp	70	1200
100	Gen. Elec.	CD	250	1200
100	Gen. Elec.	C	250	750
100	Gen. Elec.	DLC 125/250	675	675
75	Gen. Elec.	RC	250	1200
75	Gen. Elec.	RC36	125	1200
60	Whse.	SK160	250	1150
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	EW 125/250		1200
50	Gen. Elec.	R.C. 14	250	1200
50	Cr. Wheeler	50H	250	900
45	Cr. Wh. b.b.	FH	125	1750
40	Whse.	SK	250	1200
25	Gen. Elec.	CD	250	1500
25	G.E. b.b. New	CDM93	125	1450

A. C. MOTORS—25 CYCLE

HP	Mfr	Type	Volts	Speed
150	Whse.	HF	440	600
60	Allis Ch.	ARY	440	1500
60	Gen. Elec. Int.	MTC5337	440	750
60	Gen. Elec.	I-K	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
500	Allis Ch.	3 brg.	240/480	360
300	Gen. Elec.	ATB	600	720
275	G.E. 25 cycle	ATI	450	750
250	Whse.	G	2400/480	900
225	Gen. Elec.	ATB	240/480	600
187	Gen. Elec.	ATB	240/480	900
150	Elec. Machy.	3 brg.	240/480	514
150	Gen. Elec.	ATB	240/480	720
125	Gen. Elec.	ATB	240/480	900
75	El. Machy.		2300	900
75	Gen. Elec.	ATI	240/480	1200

A. C. MOTORS—SLIP RING
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	G.E. New 2200/4150V.	M574	900
1—	500	G.E. 3 brg.	I-M	450
1—	400	Gen. Elec.	I-M	514
1—	300	Allis Ch. 2300V.	ANY	720
1—	300	G.E. 2300V.	I-M	1800
1—	250	G.E. 2300V.	IM-17A	600
1—	250	Allis Ch. 2300V.	ANY	514
1—	250	Cr. Wheeler	SB	600
1—	200	Cr. Wheeler	SB	600
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Gen. Elec.	I-M-17	450
1—	150	G.E.	IM-16	600
2—	125	G.E. New	M-6333	900
1—	125	G.E. New b.b.	M-6325	1200
2—	100	G.E. New	M-6324	1200
2—	100	Gen. Elec.	I-M	1800
1—	100	G.E. Vertical	MT583	1200
1—	100	Gen. Elec.	IM-15A	514
1—	100	Northwestern	HW75A	900
1—	100	Cr. Wheeler	SR	600
1—	100	Northwestern	HW	1800
1—	75	Gen. Elec.	MT558	600
1—	75	G.E. 2200V.	MT556	720
1—	75	Gen. Elec.	MT537	1800
1—	75	Whse. 2200V.	CW	600
1—	60	G.E. TEFC b.b.	M-6326	720
1—	60	Fair. Morse	BV	720
1—	60	Whse. 2200V.	CW716C	900
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Gen. Elec. Int.	ITC5013	600
2—	40	Whse.	CW836A	1200
1—	40	Allis Ch. b.b.	ABY	1200

A. C. MOTORS—SYNCHRONOUS

HP	Mfr	Type	Volts	Speed
600	Gen. Elec. (2)	TS	2200	514
300	Gen. Elec.	ATI	2300/550	450
300	Whse.	G	2200/440	600
300	Gen. Elec.	ATI	440	720
275	G.E. 25 cycle		220/440	750
250	G.E. 3 brg. .8PF	ATI	220/440	600
250	Gen. Elec.	TS	220/440	360
200	G.E.	TS	220/440	150
190	El. Machy.	3 brg.	220/440	514
150	Gen. Elec.	ATI	220/440	720
150	Gen. Elec.	ATI	220/440	300
125	El. Machy. (2)		220/440	1800
120	Burke b.b. .8PF	AC19	2300/440	1200
125	El. Machy.	B.B.	2400/4800	900
100	American b.b.	YGH	220/440	900

A. C. MOTORS—SQUIRREL CAGE
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
2—	500	Fair. Morse 2300V.	HS	1200
1—	325	Gen. Elec.	KT429	450
1—	300	G.E. 2300V.	KTP581	1800
1—	300	Gen. Elec.	I-R	600
2—	250	Whse. 2200V.	CS	1200
1—	250	Gen. Elec.	FT548AZ	3600
1—	250	Gen. Elec.	IK-17A	450
1—	250	Gen. Elec.	IK-17	600
1—	200	Gen. Elec.	I-R	600
1—	200	Whse. b.b. NEW	CS875	1800
1—	200	G.E. 3 brg.	I-K	400
1—	200/112	G.E.	KP559	1200/900
1—	150	Ideal 2300V.	A-327	1800
1—	150	Gen. Elec. TEFC b.b.	K4338	1200
1—	150	Gen. Elec. 2200V.	IK-13A	1800
1—	150	Gen. Elec.	IK-17	450
2—	125	G.E. New b.b. HT	KG6324	1200
1—	125	Gen. 2200V. b.b.	SO	1800
1—	125	F.M. 2200V. vertical	UH-16D	1200
2—	125	G.E. 2200V. TEFC	K6326	3600
1—	125	Reliance b.b. New	5058	1800
2—	100	Gen. Elec.	KT356	900
2—	100	Gen. Elec.	I-K	1200
1—	100	Gen. Elec.	I-K	720
1—	100	Gen. Elec. b.b. NEW	K5043	1800
1—	75	Fair. Morse b.b.	HJQ	600
1—	75	Reliance b.b. NEW	C5084	900
2—	75	Reliance b.b. NEW	C505	1800
1—	75	G.E. TEFC 2300V.	K-6325	1800
2—	75	Gen. Elec.	KT543	1200
2—	75	Gen. Elec.	I-K-14	600
1—	60	G.E. Expl. Pf.	K6325	1200
2—	60	G.E. Vertical	KT536	1200
1—	60	Gen. Elec.	I-K	600
2—	60	G.E. 2200V.	KT533	1800
1—	60	G.E. hiterq	KG5504	1200
2—	60	Reliance b.b. NEW	B504	1800
1—	60	Reliance TEFC NEW	C505	1200
1—	50	Rel. TEFC New	B1445R	1800
2—	50	Gen. Elec.	KT548	720
1—	50	Gen. Elec.	KT536	450
2—	50	G.E. Vertical	KT546	720
2—	50	Reliance b.b. New	CC504U	900
2—	50	Whse.	CS	1200
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
1—	50	Whse. hiflp	WL407	900
1—	50	Allis Ch. 2300V.	AB445	1800

QUICK SHIPMENT FROM STOCK — LOW PRICES — FULL GUARANTEE
Send for Complete Stock List

Arthur Wagner Co.
1835 W. RANDOLPH ST. CHICAGO 7, ILLINOIS

FOR SALE
COMPLETE
STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Ebasco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, with Hoppers, Automatic Coal Conveyors, Automatic Ash Conveyor, 36" x 24" Jeffrey Flex-Tooth Coal Crusher.

1—705 HP Stirling 4 dum BOILER with B&W U-type superheater.

1—10,000 KW Allis-Chalmers STEAM TURBINE.

1—7,500 KW Allis-Chalmers STEAM TURBINE.

1—7,500 KW General Electric STEAM TURBINE.

All with complete control equipment.

Send for complete inventory in Denver.

MORSE BROS. MACHINERY COMPANY
2900 BRIGHTON BLVD.
BOX 1708 DENVER 1, COLORADO

TURBO-GENERATORS, AC-DC

1—1000 KVA, G.E., 440 V, 3/60, Turbine, G.E. 250/440# G., condensing. UNUSED,

2—125 KVA, G.E. 110/240/480 V, 3/60, 4 wire, 3600 RPM, Turbine, 150/250# G, condensing.

1—100 KW, Westgh. 125 V, DC, 900 RPM, Turbine, 250# G.

3—100 KW, G.E. 125 V, DC, Turbine, 275# Condensing and non-condensing.

2—150 KW, G.E., 120/240 V, DC, 3 wire, Turbine, Moore, 190# G.

1—200 KW, C-W, 120 V, DC, Turbine, Worthington-Moore, 250# G. UNUSED.

Sundfelt Equipment Company, Inc.
220 Hudson Street, Seattle 8, Wash.

1—300 & 2—200 HP Low Head WT Boilers
200 HP Al.-Ch. Slip Rg. Motor 600 RPM
2—10 Ton OET Cranes Cab & Floor Optd.
675—S12—260—125 KVA Eng. Gen. Sets
900 CFM Portable Air Compressor 2-stage
600 HP Sect. Header; 500 HP Stirling Boilers

H. & P., 6719 Etzel, St. Louis 14, Mo.

SELLING FOR CUSTOMERS

2000 KW 2300/3/60 G.E. 450 lb. condensing turbine.
1000 KW 2300/3/60 G.E. 175 lb. operating pressure.
300 KW Westh. 150 lb. non-condensing turbine.
(3) 1200 amps. 600 V. 3-pole Westh. air breakers.
150 HP 720 RPM 220/3/60 G.E. Syn mtr. with Str.
30 & 200 KW M.G. Sets Gen. 250 volt D.C.

H. BLANE JOHNSON & Associates
53 W. Jackson Blvd., Chicago 4, Ill.

asme — BOILERS — Nat'l B'd.

2—404 H.P. Springfield sectional header
1—250 H.P. Stirling, Class-H. Coxe Stoker
2—400 H.P. built in 1942 (used 3 years) COMPLETE PLANT, forced & induced draft fans, stacks, Spreader stokers & oil burners.

H. P. BREARLEY
34-23 91st STREET, JACKSON HEIGHTS, N. Y.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

LAND can help you meet your Production Schedule with

Guaranteed Electrical Equipment

1 YEAR GUARANTEE

1 to 50 HP
NEW and REBUILT
TEFC—EX. PR.—Drip proof and Splash proof
IN STOCK

SQUIRREL CAGE MOTORS
3 phase

H.P.	Make	Type	Speed
200	G.E.	KT557	1760
200	G.E.	KF-6335	880
150	West.	CS	580
150	G.E.	IK	870
150	West.	CS	870
125	Century (8)	SCN	1150
100	Century (7)	SCN	1150
100	Wagner (2) (NEW)	XP	1150
100	G.E.	K-544	1175
100	West.	CS	870
100	Al.Ch.		690
75	West. (2)	CS-654C	1750
75	G.E. (8)	K-505	1175
75	G.E.	IK	900
75	G.E.	KT-352	865
75	West.	CS	720
60	F-M	TEFC (2)	1750
60	Howell	SCR	1800
60	West. (2)	CS-607	880
60	Rel.	AA	875
60	G.E.	KT-346	865
60	G.E. (2)	TEFC(GH)	427
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	West.	CS	1740
50	West.	XP	1150
50	G.E.	KF-445	1170
50	West.	CS-642C	1160
50	West. (3)	CS	870
50	G.E. (2)	IK	870
50	G.E.	FTR-542	870
50	West.	CS	690
40	G.E.	TEFC(GH)	561

SLIPRING MOTORS
3 phase

H.P.	Make	Type	Speed
600	Cr.Wh.	131AQ	867
500	G.E. (2)	IM	450
500	Ideal		1150
225	Wagner	25 cy.	710
200	G.E. (2)	IM	1170
150	Wagner	31VRN	900
150	Burke		720
125	Burke		600
75	West.	CW	720
75	G.E.	MT556	900
75	G.E.	IM	690
60	West.	HF	850
60	Al.Ch.		690
50	G.E.	MT-536	1150
50	West.	CW	1150
50	L. A.	OGH	870
50	F-M	BV	600
50	Al.Ch.	ARY	575
50	G.E.	IM	490

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
475	West.		720
300	G.E.	ATI	900
260	G.E.	TS	900
200	Ideal	SMW	257
200	West.	Unused	900
180	G.E.	ATI	900
150	G.E.	ATI	900
125	G.E.	ATI	900
135	West.	G	1200
135	Ideal		1200
100	Elec.Prods.		1200
55	El.Machry.	BRKT	1200

230 V.D.C. MOTORS

H.P.	Make	Type	Speed
200	West.	SK210	575
100	Al.Ch.		1150
90/45	G.E.	RF-17	950/475
75	Sprague		1000/1500
75	G.E.	RC36	860
75	West. (2)	SK-180	475
75	Cr.Wh.	CMC	375/950
75	E-D	25S	450/1350
75	West.	SK151	250/1000
60	West. (3)	SK-160	680
50	G.E.	RC-12	1750
45/90	G.E.	RF-17	475/1950
50	West. (3)	SK-160	565
50	G.E.	RF-17	250/1000
50	West.	SK	250/1000
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC-31	1700
40	G.E.	RC-32	1100
40	G.E.	RC-34	750
40	G.E. (2)	CD-1441	400/1500
40	Cr.Wh.	CCM	700
40	Rel.	461T	400/1200
35	West.	SK	250/1000
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West. (2)	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	G.E.	*CDM-77	1750
25	E.D.	10S	1500
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	800
25	G.E.	RF-14	800/1200

115 V.D.C. MOTORS

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CMC	900
40	G.E.	CD-113	850
30	West.	S	600
25	G.E. (2)	CD	1800
25	West.	SK-103	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
15	E.D.	7½S	650/1230
15	Cr.Wh.	CM	650
10	Al.Ch.		900
10	E.D.	7½S	425/1700

550 V.D.C. MOTORS

H.P.	Make	Type	Speed
765	G.E. (3)	MPC	1045/1350

AC GENERATORS

KW	Make	Type	Speed
180	G.E.	ATB	900
100	G.E.	ATB	360
50	F-M	GG	1200
15	G.E.	ASI	1200

AC GENERATORS
Driven by DC Motors

KVA	Make	D. C. Input	A. C. Output
62½	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	El. Machry.	230	440
18	G.E. (3)	230	120/240
10	Burke	115	120
7½	Hertner	115	440
6¼	G.E.	230	240
5	El.Spec.	115	110
1¼	Al. Ch.	230	110

600 V.D.C. GENERATORS

KW	Make	Speed
400	G. E. (4)	1200
225	G. E.	1200
30	Burke	1750
20	Reliance	1150

GENERATORS
250 V.D.C. Motor Driven

KW	Make	Speed
300	Elliott	1200
250	G. E.	1150
200	G. E.	1200
200	West. Roto-trol	1200
150	West.	900
100	Delco	1200
100	G. E.	700
75	G. E.	1200
40	Rel.	1750
42	ABC (2)	1200
30	G. E.	1200
25	G. E.	1200

125 V.D.C. Motor Driven

KW	Make	Speed
150	West.	1150
100	West. (2)	900
100	G. E.	1200
100	El. Machry.	1200
50	West. (2)	1150
30	G. E.	1150
30	L. A.	1450
25	El. Machry.	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
125	Hobart (8)	7½
1500	Century	24
2000	G. E.	24V
100	G. E.	30
1000	G. E.	33
150	Watton	40
1000	Chandeysson	40
200	G. E.	42
1500	G. E.	50
1500	Century	60
1500	G. E.	60
1000	G. E.	75

FREQUENCY CHANGERS AND GENERATORS

Size	Make	Output Frequency
150 KW	G. E.	150 cy.
154 KVA	G. E.	150 cy.
15 KW	G. E.	400 cy.
10 KW	G. E.	200/700 cy.
7½ KW	G. E.	400 cy.
3 KW	G. E.	400 cy.

STARTERS—A. C.

1—250 H.P. C-H Bulletin No. 9589 4150V.
1—200 H.P. G.E. CR-7065, 440V.
2—100 H.P. C-H 220 V. Synch.
40—C-H and A-B; 2 and 4 speed.

STARTERS—D. C.

1—600 H.P. 230V. West. magnetic.
150—New 230V. D.C. magnetic starters, from 5 H.P. to 75 H.P., C-H, G.E., etc.
40—New 7½ H.P. 230V. magnetic reversing.
1—300 H.P. West. 115V. magnetic.

TRAVELING CRANES

2 Ton Harnischfeger, 26' 8¼" Span

GUARANTEE YOUR INVESTMENTS!

- LAND gives 1 year guarantee.
- All equipment listed in stock.
- You can see your machines run and tested under power before shipment.
- Complete shop facilities with thoroughly trained & experienced mechanics (many have been with us over 25 years).
- Responsible Organization — 41 years' experience.

Partial List ONLY

EST. 1910 — L. J. LAND INC. — 41st YEAR

156 GRAND STREET — Phone CAnal 6-6976 — NEW YORK 13, N. Y.

here's the reason...

...YOU CAN DEPEND ON A-1 PERFORMANCE

GENERAL REBUILDING

Precision equipment in the hands of Chicago Electric "Craftsmen" is the basis for general rebuilding operations on your job. Your motor or other equipment is stripped and given a thorough check and then rebuilt to perform as per original specifications and meet the terms of our guarantee.

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
1000	*G.E.	KS547S	1800
750	*G.E.	KT	720
600	*A.C. (New)	AZ	3600
500	*G.E.	PBG	1800
500	*Fr.-Morse	HS	1200
450	*G.E.	KF-567S	1200
400	*Cent. (New)	NZ	1800
400	*Al-Ch.	ARWW	900
300	*Westgh.	CS	3600
300	G.E.	IE	1200
300	Al-Ch.	AR	900
300	Westgh.	CS	514
250	West. (New)	CS	1800
250	Al-Ch. (New)	ARW	900
250	L-Allis	1468	720
250	Westgh.	CS	900
150	G.E.	KT	1800
150	G.E.	IE	1800
150	*Al-Ch. (New)	ARW	1800
150	G.E.	IE	1200
150	Westgh.	CS850A	600
125	West. (New)	CS804	3600
125	*Al.-Ch.	AR228	1800
125	G.E. (TEFC)	K6326B	1200
125	Westgh.	CS	900
125	G.E. (New)	K6333	900
100	Al-Ch. (New)	ARWWT	3600
100	*G.E.	FT542Z	1800
100	G.E.	TTRP	1800
100	*Westgh.	CS	1200
100	U.S. (Vert.)	CFU	1200
100	Burke	EM	1200
100	Westgh.	CS	1200
100	Cent. (New)	SC-585	900
100	G.E. (New)	K6333	720
75	Westgh.	CS761	1800
75	West. (New)	CS505S	1800
75	G.E.	K505	1200
75	G.E.	KT346	1200
75	*West.(Vert.)	CS	900
75	Ideal	AA350	720
75	*G.E.	IK	720
75	G.E.	FT-556	720
75	Triumph	TR16	514
60	West. (Vert.)	CSW445	1800
60	G.E. (New)	K504U	1200
60	Al-Ch. (New)	AR823D	900
60	Al-Ch.	AR828F	514
50	G.E.	KT527	1800
50	U.S. (Vert.)	SCV	1800
50	Westgh.	CS640	1800
50	Westgh.	CS504	1200
50	G.E.	KT343	1200
50	*G.E.	KT342	900

Hundreds of Smaller Motors!

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 volts (*2200 volts or higher)

H.P.	Make	Type	Speed
2000	*G.E.	MT30	240
1200	*Cr.-Wh.		240
800	*Al.-Ch.	3 Brg.	450
650	Westgh.	HE	350
500	Westgh.	CW	350
300	*G.E.	IM	1800
280	G.E.	MT	450
200	G.E.	IM	1800
150	West. (New)	CW772C	1200
125	G.E. (New)	M6333	900
125	G.E. (New)	M6334	720
100	G.E.	MT	1800
100	Al-Ch.	ANY	900
100	G.E.	IM	720
100	Westgh.	CW	600
100	G.E.	IM	450
75	Wkr.	G500	900
60	G.E. (New)	M505	1200
60	Westgh.	CW	900
50	G.E.	IM	1800
50	Al.-Ch.	ANY	1800
50	Westgh.	CW	1200
50	G.E.	MT	720
50	G.E.	IM	420
40	G.E.	MT330	1200
40	Westgh.	CW-844	900
40	G.E. (New)	M504U	900
40	Al-Ch.	ARY223	720
35	F-M (Vert.)	UAB	1200
35	G.E.	IM	1200
30	Westgh.	CW	1800
30	Westgh.	CW445	1800
25	G.E.	IM	1200
25	Al-Ch.	ARY-220	900
20	Al.-Ch.	ARY-218	1200
20	G.E.	MT512	1200

SLIP RING MOTORS

Crane and Hoist Type 3/60/220 or 440 volt

H.P.	Make	Type	Speed
75	Westgh.	CI756A	600
37	G.E.	HITC TENV	600
30	G.E.	ITC5010	1200
25	Westgh.	CI572	900
20	Westgh.	CI	900
15	G.E.	ITC5010 25Cy.	720
11	Westgh.	CI464	900
6½	R & M	425A TENV	1200
3	G.E.	MR254 TENV	1200

TURBINE SPECIAL

312 KVA Crocker - Wheeler AC Generator, 3/60/240/480 volt, d/a 1a

375 HP Worthington - Moore Turbine, Single Automatic, Non-Condensing, 425# PSI, 10# Exh., 60°F SH with Reduction Gear and Accessories

AC SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

H.P.	Make	Type	P.F.	Speed
800	G.E.	TS984	1.0	1800
750	*Westgh.		.8	900
700	G.E.	TS		514
320	*Al-Ch.	Dr Pf	1.0	720
300	Cr-Wh.	Eng.	1.0	300
250	*Al-Ch.	Dr Pf	.8	720
200	El. Machy.	Pad	1.0	450
150	El. Machy.	EM	.8	720
150	*Westgh.		1.0	300
125	*El. Machy.	Syn	1.0	900
125	Cr.-Wh.	101-S	1.0	900
125	*G.E.	TS	1.0	277
115	E.-M.	EM	1.0	240
100	Cr.-Wh.	103S	.8	900
100	*G.E.	ATB	.8	900
100	Ideal	SMS	1.0	900
75	G.E.	ATI	1.0	900
60	G.E.	TS7336	1.0	1200
40	G.E.	ATB	.8	1200
20	Fynn W.	15VRN		1200
15	Century	ARC365	1.0	1200
4	G.E.	AK (25 Cy.)		1500

AC SYNCHRONOUS GENERATORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

KVA	Make	Type	P.F.	Speed
1500	G.E.	ATI	.8	900
1000	*Westgh.	503D	.8	900
250	*Al-Ch. (New)		.8	720
150	El. Mach.	EM	.8	720
112.5	*G.E.	ATB	.8	1200
110	Cr.-Wh.	103	.8	900
100	*G.E.	ATB	.8	900
60	Fr.-Morse	B	.8	900
55	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200
50	Cr-Wh.	5686	.8	1200
50	Westgh.		.8	1200
37.5	Al-Ch.	EA121	.8	1800

TRANSFORMERS

4—2500 KVA Westinghouse, 1 Ph., 60,000 V. Primary, 13,800 V. Secondary

1—750 KVA Westinghouse—AIR, 3 Ph. 12,000 V. Primary, 480 volts Secondary

1—750 KVA Westinghouse—Air, 3 Ph. 13,800 V. Primary, 2,300 V. Secondary

3—300 KVA General Electric, 3 Ph. 13,800 V. Primary, 240/480 V. Secondary

3—300 KVA General Electric, 3 Ph. 2400 V. Primary, 240/480 V. Secondary

3—250 KVA General Electric, 1 phase 2400/4160 volts Primary. 240/480 volts Secondary

6—167 KVA General Electric, 1 Ph. 2300/4160 V. Primary, 240/480 V. Secondary

3—150 KVA General Electric, 1 Ph. 33,000 V. Primary, 240/480 volts Secondary

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
900	Westgh.	2300	250
500	Westgh.	550	250
500	Cr-Wh.	220/440	250
450	G.E. (3 Unit)	2300	125/250
400	Westgh.	2360	600
250	Westgh.-G.E.	440	250
200	Cr.-Wh.	440	250
200	Ridgeway	2200	250
150	G.E.	2300/440	250
150	G.E.	440	250/275
150	Cr.-Wh.	440	250
150	Al-Ch.	220	125
100	G.E.	440	250
100	G.E.	220	250
100	G.E. Delco	440	120/240
75	Al-Ch.	2300	110
75	Westgh.	2300	110
60	Al-Ch.	2300	110
40	Cr-Wh.	220	125
40	Elec. P—G.E.	440	250
40	Al-Ch.	440	250
30	Cr-Wh.	220	125
25	G.E.	440	250
20	G.E.	440	250
20	G.E.	440	125
10	Cr-Wh.	220	125
10	G.E.	440	250

D.C. TO A.C.

100	G.E.	230	250

BALANCING SETS

4—34 KW, 250 V., 270 A. Neut. Bogue, Type MCI, 125 V. Gen. BB Comp'd. on Fab. Base, d/e.

2—20 KW, 250 V., 160 A., Neut. Crocker-Wheeler, Type 151, 125 V. Gen. 3 Sl. Bearings, close-coupled.

AIR COMPRESSORS

Size	M	Make	Type	Displ.	Press
10	x10	Ing. R.	ERI	223	120
10	x8	Ing. R.	DRI	179	65
9	x9	Worth.	HB	211	100
9	x8	Ing. R.	ERI	145	100
8½	x9	Worth.	HB	179	100
7	x7	Worth.	HB	122	100

DIRECT CURRENT MOTORS 230 VOLTS

H.P.	Make	Type	Speed
375	Westgh.	Pad	650
200	Westgh.	RK210	900
175	Reliance	1400T	675
175	G.E.	ELC11	750
100	G.E.	MC34	2300
100	Westgh.	SK173	850
100	Al-Ch.	E152	575
40	Cr-Wh.	CMC	1750
40	G.E.	CD2004	800
35	Cr-Wh.	CM351	700
35	G.E.	C	600
30	Westgh.	SK120	975
30	Cr-Wh.	CM	450
30	Westgh.	SK93	1750
30	G.E.	RC31B	1150
25	Westgh.	SK100L	1100
25	Westgh.	SK	900
25	Al-Ch.	E-150	700
20	Westgh.	SK83	1750
20	G.E.	RC	1150
20	G.E.	LC	575
20	G.E.	HC	800

CHANDEYSSON Amplidyne

NEW 1000 AMP. 40 volt, type NPT, d/e 60 H.P. Chan. A-28 Syn. Motor 3/60/220, 600 RPM, 25 deg. cont.

ROTARY CONVERTER

1000 KW Westinghouse, 900 RPM, 600 V DC, 4700/4280 V AC, 8 HP. 60 sy. with complete starting equipment

HI-PRESSURE PUMPS

GPM	Make	Type	Head
800	Worth.	6DS	925 Ft.
500	Manistee	H	250 Ft.
300	Al-Ch.	NMZ	800 Ft.

First Source for 41 Years for Quality Electrical Equipment

CHICAGO Electric Co.

1320 W. CERMAK ROAD CHICAGO 8, ILL.

DIESEL GENERATOR SETS

75 KW General Motors Diesel, Model 8-71, 1800 RPM, Electric start. Inc. Radiator, and switchboard, AC, 3/60/120/208 volts.

60 KW Gen'l Motors Diesel, Model 8-71, 1200 RPM, elec. start. Inc. Radiator, and switchboard, AC, 3/60/120/208 volts.

50 KW International Harvester set, Model RD-18A, 1200 RPM, 3/60/120/208 volts.

Other Sizes in Stock, AC & DC Units.

ALJON ELECTRIC DIESEL CO.
904 Pacific St. Brooklyn 16, N. Y.

The Stephen A. Douglass Co.

offers

COMPLETE OPERATING PLANT

(A-1 CONDITION)

TOTAL—1500 KW condensing bleeder.
TOTAL BOILERS—84,000 lbs. steam pr. hr.

DIESELS — TRANSFORMERS

3 Combustion Eng. Co. Boilers, 35,000 lbs. per hr. @ 450 p.s.i. sectional header.

? What do you require ?

630 Fort Washington Ave., N. Y. 33, N. Y.

NEW
2 DIESEL ENGINE GENERATOR SETS

25 KW, 3 phase, 4 wire, 600 rpm. Completely equipped with all accessories. Never used.

JOHNSON MACHINERY CO.
59 Edison Place Newark 2, N. J.
Mitchell 3-7608

BOILERS

10 to 1000 H.P.

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

BOILER

1—1300 HP WALSH-WIDENER BOILER, sectional header, cross drum, 225 lbs. pressure.

Ask for our BOILER list.

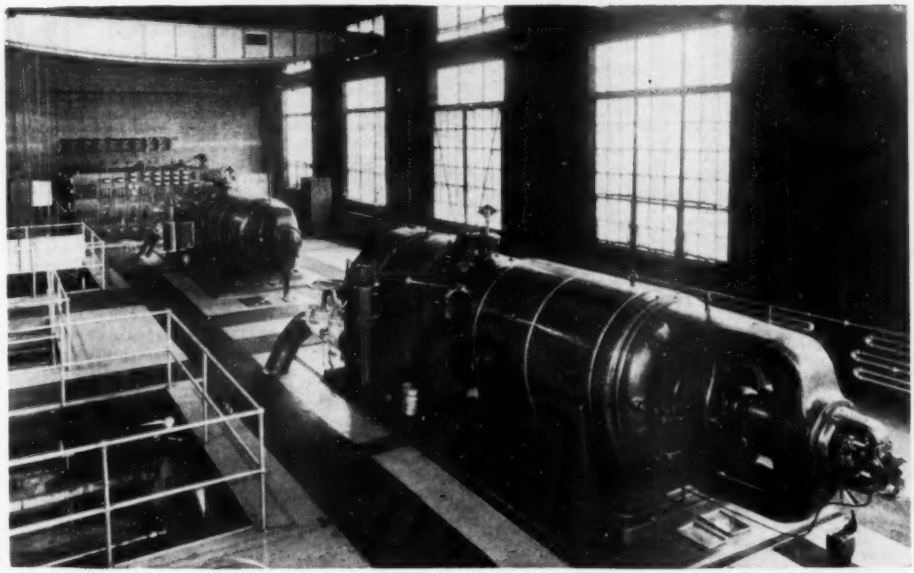
WARNER J. SHERB, INC.
342 Madison Ave., New York, N. Y.
Murray Hill 2-9098

For Sale—Boilers, Stokers, Turbines, Tanks
3 Drum Low Head—300/400/600 HP Boilers
100 HP Erie Economic Boiler—200 lbs. pressure
8—500 HP Sectional Header B & W Boilers—200 lbs. pressure
5000 KW Turbines—Corliss Engines all sizes
75,000 Gal. Tanks—Foamite System
2—6,500,000 Gal. Tanks
1—381 KW—250 V D.C. Gas Engine Generator Sets
WE BUY AND SELL POWER MACHINERY
H. A. WOODWORTH ENGINEERING CO.
611 OLIVE ST., ST. LOUIS (1) MO.

2500 KW. @ .80, 3125-KVA. Two (2) G.E. TURBO-GENERATORS

DUPLICATES: ARE AS GOOD AS THEY LOOK

Send for Free Bulletin #900 — Contains Specifications



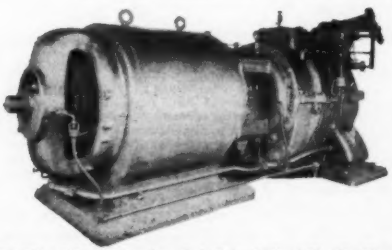
Our 2—3125-KVA., G.E. Condensing Units (Above) are Ready for Immediate Delivery and Installation. Are Complete with all parts including Condensers and Auxiliaries. Surface Type, 6750-sq. ft., capacity. Are Unusually Good Machines. WIRE OR WRITE FOR INSPECTION AGREEMENT.

JUNE SPECIAL

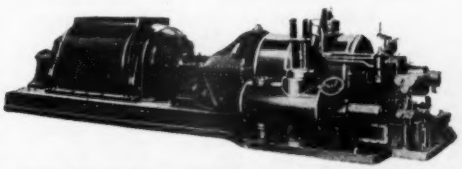
2 BOILERS: B&W., 850# psi., 825°FTT., 100,000# Steam per Hr.
COMBUSTION: 450# psi., 7500 FTT., 70,000 Steam per Hr.
Oil, Gas or Coal Fired. Pass Any Inspection. Investigate Now.

IN OUR STOCK

25 Complete Turbine Sets, 500 to 20,000-KW. Cond. & Non-Cond. Diesels—a Full Line: Boilers, the Same.



A 750-KW., G.E., Condensing, Aut. Extr., 90% of Throttle Flow at 15#, 215# psig., 3/60/2300-v., 937-KVA., 3600-RPM. Condition, Pass any Inspection. Complete Unit Condenser Switchboard, Exciter. INVESTIGATE NOW. Turbine Serial, 28304: Generator, 3868840. Also 2-750, 480-Volt, Same as Above in Stock. Bulletin 975 with Specs. Illustrated Is Free.



Above Allis-Chalmers 1500-KW., .8% pf. Never used since U.S. Govt., spent $8000 rebuilding it, account changed their plans. Steam psig., 150/200#, .8% pf., 1875 KVA., Generator 3/60/2300-v., 3600-RPM. Good for 15 yrs. cont. service with no repairs. PRICED FOR QUICK SALE. Bulletin 500.

CORRESPONDENCE INVITED

TELEPHONE, WIRE OR WRITE

CHARLES WEAVER, M.E.

OWNER

4145 PENOBSCOT BUILDING, DETROIT 26, MICHIGAN

TELEPHONES
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-6038

OUR BEAUTIFUL BULLETINS (In Colors) Mailed on Request.

Always Get Weaver's Prices. Are Big Money Savers. We Own All Equipment We Offer.

220/440 Volt, 60 cycle **SQUIRREL CAGE** open, 3 Phase

GUARANTEED REBUILT

QN.	HP	MAKE	TYPE	BEARING	SPEED
1	200	G.E.	IK	S.B.	900
1	200	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	900
1	150	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	1800
2	125	Kilsa		S.B.*	1800
1	100	West.	NS	S.B.	1200
1	100	West.	CS	S.B.	720
3	100	G.E.	IK	S.B.	720
1	100	G.E.	KT-347	S.B.	1200
2	100	G.E.	IK	S.B.	900
1	100	G.E.	IK	S.B.	1800†
1	100	G.E.	IK	S.B.	1800
1	100	West.	CS-504	S.B.	1800
1	75	G.E.	IK	S.B.	600
2	75	G.E.	IK	S.B.	720
3	75	West.	CS-752C	S.B.	900
1	75	G.E.	K-508	S.B.	1200
1	75	G.E.	IK	S.B.	1800†
2	75	G.E.	IK	S.B.	900
4	75	West.	CS	S.B.	1200
4	75	G.E.	IK	S.B.	1200
3	75	F.M.	QS-445	S.B.	1800
2	75	G.E.	IK	S.B.	600
1	60	G.E.	IK	S.B.	1200
1	60	G.E.	KT-348	S.B.	900
1	60	G.E.	IK	S.B.	1200
1	60	F.M.	QS-444	S.B.	1200
1	60	G.E.	KT-333	S.B.	1800
4	60	G.E.	IK	S.B.	1800
1	50	G.E.	IK	S.B.	600
3	50	West.	CS	S.B.	900
1	50	G.E.	KT-342	S.B.	900
1	50	G.E.	KT-342	S.B.	900†
2	50	West.	CS-443	S.B.	1200
1	50	G.E.	KT-327	S.B.	1800
2	50	G.E.	IK	S.B.	1800†
3	50	G.E.	IK	S.B.	1800
1	40	G.E.	KT-342	S.B.	720
1	40	F.M.	BH12D	S.B.	900
1	40	G.E.	KT-338	S.B.	900
1	40	West.	CS	S.B.	1200
2	40	G.E.	IK	S.B.	1800†
2	40	G.E.	IK	S.B.	1800
1	35	G.E.	IK	S.B.	720
1	35	Triumph	B12	S.B.	900
3	30	G.E.	KT-312	S.B.	1800
3	30	G.E.	IK	S.B.	1800
5	30	West.	K-505	S.B.*	3600
1	25	G.E.	IK	S.B.	720
1	25	F.M.	B12P	S.B.	720
1	25	Century	SC-30	S.B.	1200
1	25	F.M.	BH12A	S.B.	1200
1	25	Ideal	A 10	S.B.	1200
1	25	West.	CS-471	S.B.	1800
1	20	F.M.	KBV	S.B.	1200
1	20	G.E.	KT-322	S.B.	1200
1	20	G.E.	KT-312	S.B.	1200
1	20	G.E.	K-504	S.B.	1800
1	20	West.	CS-504	S.B.	1800
2	20	G.E.	K-328	S.B.	3600
4	20	Linc-Weld	Frame 328	S.B.	3600
2	15	West.	CS	S.B.	720
1	15	Wagner	15 T	S.B.	1200
1	15	Ideal	A	S.B.	1200
1	15	G.E.	KT-302	S.B.	1200
1	15	G.E.	KT-752	S.B.	1800
1	10	G.E.	IK	S.B.	1200
1	10	G.E.	KT-752	S.B.	1200

* Splash proof † 2200 volt

SLIP RING MOTORS

We offer from stock the following 220/440 volt, 60 cycle, 3 phase, GUARANTEED REBUILT equipment, unless otherwise noted.

QUAN.	H.P.	MAKE	TYPE	SPEED	DESCRIPTION
1	15	G.E.	MT 512	900	S.B.
1	30	G.E.	MT 532	900	
1	30	Al. Ch.	ANY	600	
2	40	Al. Ch.	ARY 444	1500	splash proof, S.B.
1	40	G.E.	MT 536	900	S.B.
1	50	G.E.	I-M	900	S.B.
2	60	G.E.	MT 558	600	
1	60	G.E.	MT 548	900	
1	60	G.E.	I-M	900	
1	90	West.	CW 505	1700	
1	75	G.E.	I-M	720	
1	100	G.E.	I-M	720	
1	100	G.E.	I-M	900	
1	125	G.E.	I-M	720	
1	150	G.E.	I-M	600	
1	150	G.E.	I-M	1800	2300 volt
1	200	G.E.	I-M	900	

TOTALLY ENCLOSED MOTORS

FAN COOLED, BALL BEARING, 220/440 volt, 60 cycle, 3 phase, GUARANTEED REBUILT, unless otherwise noted.

QUAN.	H.P.	MAKE	TYPE	SPEED	DESCRIPTION
1	7½	G.E.	KF 284	1800	
1	7½	Reliance	AA 324	1200	XP, NEW
5	10	L.A.	JS 329	1200	
1	15	West.	CB 328	1800	XP, NEW
1	25	L.A.	JS 384	1800	
1	40	G.E.	K 488	1800	XP, NEW
1	50	Master	FB 404	3600	XP, NEW
1	50	Al. Ch.	ARZZ 444	1800	NEW
1	75	G.E.	K 505	1200	

POWER EQUIPMENT COMPANY

8 CAIRN STREET — P. O. BOX 534 — ROCHESTER 2, N. Y.

Telephone: Genesee 5629

MOTORS - M. G. SETS - COMPRESSORS, ETC.

FAST SHIPMENT

MOTOR GENERATOR SETS

3 ph. 60 cy.

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
1250	G.E.	720	275	2200
400	West.	720	550	2300
300	Ridg.	1200	250	2300
300	West.	1200	550	4000/2300
200	Ridg.	900	250	2300
200	West.	1200	275	2300
200	G.E.	1200	275	2300
200	G.E.	1200	250	4000/2300
150	Ridg.	900	250	2300
100	Ridg.	1200	250	2300/440
75	West.	900	75	440/220
35	G.E.	1800	125	440/220

ROTARY CONVERTERS

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
500	G.E. HCC6	1200	250	4000/2300
300	G.E. HC12	600	250	4000/2300
300	West.	1200	250	4000/2300
300	G.E. HCC6	1200	250	4000/2300
150	G.E.	1200	250	4000/2300

AIR COMPRESSORS

356 CFM, Chg. Pr. 12"x10"—NSB 100 lbs.
500 CFM, 100#, Allis Rotary direct connected 100 H.P. S.B. Motors.

A.C. MOTORS—3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
1200	G.E.	277	MT—S.R.
600	G.E.	600	MT—S.R.
400	G.E.	450	MT—S.R.
300	G.E.	450	IM—SI.Rg.
200	G.E.	1200	MI—SI.Rg.
160	G.E.	600	IK-16—Sq. Cg.
150	West.	514	CS954—Sq. Cg.
150	G.E.	600	ATI—Syn.
100 (2)	Allis	720	ARX—Sq. Cg.
100 (4)	West.	1200	CS752C—Sq. Cg.
100 (2)	G.E.	450	IM16—SI.Rg.
75	G.E.	600	ITC5013A
50	West.	1750	CS
50/12.5	G.E.	900/450	IM 2200 v.

Also Smaller Units in Stock

TRANSFORMERS—1 Ph. 60 Cy.

KVA	MAKE	PRI.	SEC.
1—3000 (3 Ph)	G.E. Auto	25000	22000
3—500	West.	22000	2200
3—200	Al. Ch.	22000	2200
3—100	G.E	2400	120/240
3—50	G.E.	2400	120/240
2—25	West.	2400	120/240

Also Smaller Units in Stock

Send us your inquiries for any POWER EQUIPMENT you may require.

MOORHEAD ELECTRICAL MACHINERY COMPANY

361 Noblestown Road Oakdale, Penna. Pittsburgh District

FOR SALE

MODERN 1000 KW Turbo-Generator

In Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.

6101 Tacony St. Philadelphia 24, Pa.

MULTI-SPEED MOTORS

FIVE (5) — 150/100/75/50 HP — 1775/1170/890/585 RPM—3 Phase—60 Cycle — 440 Volt — General Electric — Type KT559AS — Ball Bearing — Dripproof — Motors—and Controls.

Others in Stock — Inquire

EMPIRE ELECTRIC COMPANY, INC.

87 Jay St., Brooklyn 1, N. Y.

Dept. P-S — MAin 4-5900

POWER PLANT MACHINERY

STEAM TURBINE GENERATOR UNITS

3 Phase 60 Cycle

25,000 KVA General Electric condensing, 200 lbs. steam pressure, 530° FTT, 13,200 volts, with surface condenser.

12,500 KVA Allis Chalmers condensing, 225 lbs. steam pressure, 550° FTT, 13,200 volts, with surface condenser.

6,250 KVA Allis Chalmers condensing, 200 lbs. steam pressure, 500° FTT, 2300/4,000 volts, with surface condenser.

5,000 KVA General Electric non-condensing extraction, 600 lbs. steam pressure, 750° FTT, 125/150 lbs. exhaust, 13,800/4000 volts.

5,000 KVA Westinghouse condensing double extraction, 400 lbs. steam pressure, 600° FTT, 125 lbs. and 20 lbs. extraction, 480 volts, with surface condenser.

3,750 KVA General Electric condensing, 150-250 lbs., 500° FTT, 2300/600 volts with surface or jet condenser.

2,500 KVA General Electric condensing extraction, 200 lbs. steam pressure, 550° FTT, 20 lbs. extraction, 480 volts, with surface condenser.

1,875 KVA General Electric condensing, 150-200 lbs. steam pressure, 500° FTT, 2300 volts, with surface or jet condenser.

1,250 KVA General Electric condensing, 200-400 lbs. steam pressure, 650° FTT, 2300/4150 volts, with surface condenser.

1,250 KVA General Electric non-condensing, 150-250 lbs. steam pressure, 600° FTT, 0-50 lbs. exhaust, 2400 volts.

1,250 KVA Westinghouse condensing extraction, 150-250 lbs. steam pressure, 600° FTT, 5-25 lbs. extraction, 480 volts, with surface condenser.

625 KVA Westinghouse non-condensing, 150-200 lbs. steam pressure, 600° FTT, 5-25 lbs. exhaust, 480 volts.

438 KVA Westinghouse non-condensing, 150-200 lbs. 500° FTT, 5-25 lbs. exhaust, 2300 volts.

STEAM ENGINE GENERATOR UNITS

3 Phase 60 Cycle

750 KVA Allis Chalmers-Ames vertical uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 2400/4160 volts.

625 KVA General Electric-Skinner horizontal uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 240 volts.

500 KVA Allis Chalmers-Chuse horizontal Corliss, 150 lbs. steam pressure, 10 lbs. exhaust, 480 volts.

375 KVA General Electric-Skinner horizontal uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 480 volts.

250 KVA General Electric-Ames vertical uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 480 volts.

SPECIAL

NEW 2859 KVA HIGH FREQUENCY GENERATORS

120/240 CYCLE

3—2000 KW 70% P.F. 2859 KVA New General Electric A.C. generators, 3 phase, 240 cycle, 4150 volts, type ATB-6, 4800 RPM. Can be operated at lower frequencies with proportionate reduced speeds.

DIESEL ENGINE GENERATOR UNITS

3 Phase 60 Cycle

1,675 KVA Fairbanks-Morse, 2400/600/480 volts, 300 RPM.

1,000 KVA Delavergne, 2400 volts, 200 RPM.

900 KVA Fairbanks-Morse, 2400 volts, 257 RPM.

450 KVA Alco, 480 volts, 514 RPM.

312 KVA Superior, 480 volts, 360 RPM.

300 KVA Fairbanks-Morse, 480 volts, 257 RPM.

SPECIAL

1675 KVA DIESEL ENGINE GENERATOR UNIT

1675 KVA Fairbanks-Morse generator 3 phase 60 cycle 2400 volts, 300 RPM direct connected to

1750 HP Fairbanks-Morse diesel engine, 2 cycle, 10 cylinders, Model 33E16, 300 RPM. Complete with direct connected exciter, switchgear, starting equipment, heat exchanger, air scavenger, pumps, oil reclaimer, Maxim silencer, and interconnecting piping and fittings as in operation.

This unit is a heavy duty base load machine, designed for continuous dependable service. It was installed new in 1942 and is in excellent conditon, due to the fact that it was only operated part of the time.

TRANSFORMERS

1 Phase 60 Cycle

6,667 KVA (3) General Electric 38,100/66,000 volts primary, 13,200/22,000 volts secondary.

3,333 KVA (3) Westinghouse 132,000 volts primary, 7620/13,200 volts secondary.

1,667 KVA (3) General Electric 13,800 volts primary, 4800/7245 volts secondary.

1,250 KVA (3) General Electric 23,000 volts primary, 2300/4000 volts secondary.

1,000 KVA (3) Pittsburgh 13,800 volts primary, 2400 volts secondary.

833 KVA (3) Westinghouse 22,000 volts primary, 2300 volts secondary.

333 KVA (3) Packard 13,200 volts primary, 220/440 volts secondary.

STEAM BOILERS

1,000 HP Springfield, 120,000 lbs. steam per hour, 300 lbs. steam pressure, 600° FTT, stoker fired.

720 HP (2) Combustion Engineering, 60,000 lbs. steam per hour, 450 lbs. steam pressure, 600° FTT, stoker fired.

529 HP Babcock & Wilcox, 25,000 lbs. steam per hour, 160 lbs. steam pressure, 350° FTT, wood fired.

225 HP (2) Babcock & Wilcox, 12,000 lbs. steam per hour, 200 lbs. steam pressure, 450° FTT, hand fired.

FREQUENCY CHANGER

3,750 KVA General Electric generator 3 phase 60 cycle 2300/-4000 volts direct connected to 4200 HP General Electric synchronous motor 3 phase 25 cycle 440/-22,000 volts, 300 RPM.

Write, Wire or Phone for Further Details and Prices

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. **Telephone: MAin 1-9514** **CLEVELAND 14, OHIO**

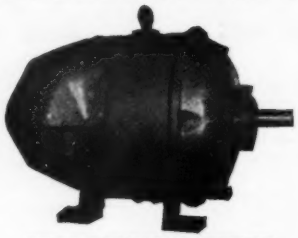
MOTORS - M.G. SETS - CONTROLS

NEW AND GUARANTEED REBUILT

DIRECT CURRENT
230 V.

Reconditioned and guaranteed

HP	RPM	Mfg.	Brgs.
150	250/1000	Rel	Sl.
50	500/1500	G.E.	Sl.
50	1150	Whse.	Sl.
40	400/1200	Rel (TE)	Ball
40	400/1600	Imper.	Ball
35	400/1200	Ideal	Sl.
30	250/1000	Whse.	S.Sl.
30	500/1500	Rel	Ball
30	700/1400	Rel (TE)	Ball
25	250/1000	G.E.	Sl.
25	400/1600	Whse.	Sl.
25	600/1350	Rel	Ball
25	690	Rel	Ball
25	1150/2300	G.E. (TE)	Ball
20	300/1200	Rel	Ball
20	500/1500	G.E.	Sl.
15	250/1000	G.E.	Sl.
15	400/1600	Whse.	Sl.
15	400/1200	G.E.	Sl.
15	575/1000	Rel	Ball
15	575/1725	L.A.	Ball
15	650/1650	G.E.	Sl.
15	700/1350	Rel	Ball
10	400/1600	Whse	Sl.
10	400/1600	Rel	Ball
10	600/1200	Rel (TE)	Ball
10	850	Rel	Ball
7½	200/1200	Whse. (TE)	Ball
7½	400/1600	Rel	Ball
7½	400/1600	Whse.	Ball
7½	600/1800	Rel (TE)	Ball
7½	1150	G.E.	Sl.
3	850/1700	Rel	Ball



NEW DIRECT CURRENT
230 volt-drip proof.

Qu.	HP	RPM	Mfg.	Frame
1	3	690/2660	G.E.	284
10	5	850/1700	G.E.	CD-66
5	7½	575/1725	G.E.	CD-77
1	10	575/2300	L.A.	4051
3	10	1750	Rel.	T-34

CRADLE TYPE DYNAMOMETER
225 HP, Whse, 250 v. DC, 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.

NEW MAGNETIC SLIP RING CONTROLS
3 ALLIS 250 HP, 440 volt (125 HP, 220 volt) Reversing, 7 accel. steps, main line air ckt. brkr., fully magnetic, open or enclosed.

M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2300	G.E.
400	125/250	2300	Ideal
125	250	220/440	Whse.
100	250	2300	G.E.
50	250	440	Ideal
30	250	440	Ideal
20	250	220/440	G.E.
3V5	250	220/440	Rel.

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
650	128	2300	Whse.	Engine
400	900	2300	Whse.	80%
300	450	2300	G.E.	100%
300	720	550	G.E.	80%
250	200	440	G.E.	100%
250	514	2300	Allis	80%
200	720	440	G.E.	100%
200	1200	440	G.E.	100%
150	600	440	G.E.	100%
100	1800	2300	Whse.	100%

SLIP RING

HP	RPM	Volts	Mfg.
500	1200	220/440	Elliott (new)
400	900	2300	G.E. (new)
350	450	2300	Whse.
300	600	440	G.E.
200	450	2300	Burke
200	900	220/440	G.E. (new)
125	900	440	G.E. (new)
100	1200	440	G.E. (new)
50	720	220	Whse.
50	900	220	G.E.
40	900	220	G.E.

Buy from BOSWICK with confidence

WAlbridge 1195

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

DIESEL POWER PLANTS

50 KW TO 1250 KW

Remanufactured—Guaranteed! Immediate Delivery!

GM 8-268A Propulsion Engine with reduction gear
GM 3-268A 100 KW AC or DC with Switchboard
GM 8-268A 200 KW AC with Switchboard
GM 12-567A 900 H. P. Marine Propulsion Complete with accessories
GM 16-278A 1600 H. P. Marine Propulsion
Superior GDB-8 150 H. P. 100 KW D.C. 3 wire with or without Generator

Also Diesel Parts

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

1442 E. Washington Blvd. Los Angeles 21, Calif.
Phone: Richmond 5269
Cable — "HEMCOY"

FOR SALE

2—Richardson Scales, type E-39, 100# per dump.
1—44 HP Terry type Z-1 Steam Turbine, gear and base 3000/600 RPM, 250# pressure.
1—50 HP Terry type Z-1 Steam turbine, gear and base 4000/1750 RPM, 250# pressure.
1—40 HP GE Motor, 1750 RPM, high starting torque, double shaft extension with 220 volt starter and free wheeling coupling.

G. M. DeROSE
2457 Woodward Ave.,
408 Donovan Bldg., Detroit 1, Mich.

SPECIAL TRANSFORMERS — YOUR SPECIFICATIONS

NEW TRANSFORMERS OIL COOLED AIR COOLED PHASE CHANGES

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS REWOUND REBUUILT RECONDITIONED

MOTOR GENERATOR SETS

125 K.W. 230 Volt D.C. Burke 440 Volt 3 phase 60 cycle 900 RPM Synchronous Motor.
100 K.W. 250 Volt D.C. Gen. Elec. 3 brg. 440 Volt 3 phase 60 cycle 900 RPM. Synchronous Motor.
50 K.W. 250 Volt D.C. Westing. 4 brg. 220/440 Volt 3 phase 60 cycle 120 RPM motor.
20 K.W. 125 volt D.C. Allis Chalmers 3 brg. 440 volt 3 phase 60 cycle 1800 RPM motor.

D. C. ENGINE GENERATOR
7½ K.W. 220 Volt 500 RPM, direct connected to Engberg 6x5, 150 lbs. B.P. engine

MOTOR REPAIR & MFG. CO.
1557 Hamilton Ave., Cleveland, Ohio

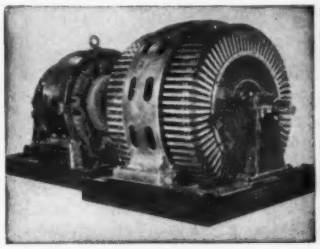
IT ISN'T RE-NU-BILT UNLESS

It Comes from

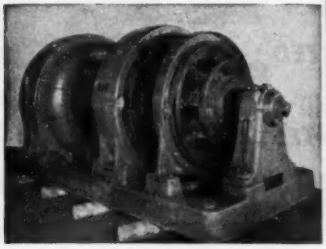
BELYEA

"SUCCESSFUL OPERATION GUARANTEED"

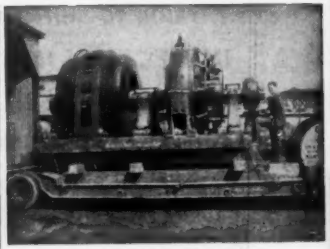
Three Recent Stock Arrivals



500 KW-MG



750 KW-MG



2000 KW-MG

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
2	2000*	G.E.	580		6600/11000
1	1800	G.E.	600	125/250	4000
1	1500	Whse.	600	600	2300/4600
1	1500	G.E.	360	275	2200/4400
1	1400	Whse.	360	700	2300
1	1000	Whse.	900	600	2300/4150
1	1000	G.E.	900	600	2300/4150
1	800	Whse (3U)	1200	600	2300
1	750	Whse.	900	250	2300
1	500	G.E.	900	600	4150
1	500	G.E.	720	125	2300/4000
1	500	Whse.	900	250	440
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	415
1	400	Whse.	1200	250	2300
1	400	G.E.	900	275	2300/4150
1	350	G.E.	900	125	2300/4150
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	Cr. Wh.	1200	250	440
1	140 (3U)	Cr. Wh.	680	125/250	2300
1	100	G.E.	1170	125	230
1	100	Delco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
6	70	G.E.	1200	70	220/440

* 25 Cycle

ROTARY CONVERTERS

60 Cycles

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1—	2000	G.E.	514	600	13500
1—	1000	Whse.	900	600	11000
1—	750	Whse.	900	600	13200

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/250 ISP 2300/3/60-Exc. & Surface Cond.
1	2500	G.E.	Auto. Ext. Cond. 800 lbs.-800° F.T.T. 175/200 Auto. Ext. 2300/3/60 Exciter & Surface Cond.
1	2500	G.E.	Condensing—150# ISP 2300 V 3 ph. 60 cy. with surface condenser. Recently Rebuilt.
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 425#-725°TT ISP-440V-3 ph. 60 cy. New—1944
1	625	Whse.	Non-condensing, 125/150# ISP, 5/20# B.P., 480 v., 3 ph., 60 cy., with exciter
1	400	Whse.	Non-condensing 125/150# ISP 5/10#BTU 40/480v. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V. D. C.
1	300	Whse.	Non-condensing 150# ISP 7# B.P. 240V. 3 ph. 60 cy.

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse.		600	525/725
1—1500	Whse.		525	600
1— 940	Whse.	QM-R.Brg.	250	140/170
1— 800/1000	Whse.		450	600/720
1— 600	Al. Ch.	MILL	230	400/800
2— 450	Whse.		550	415
1— 300/400	G.E.	DYNA	250	1325/2500
1— 350	Cr. Wh.	CCM-151H	230	1100
1— 335	Whse.	MQ	250	300/900
1— 200/300	G.E.	MPC	230	360/820
1— 250	G.E.	MPC	230	400/500
1— 150	G.E.		600	250/750
10— 150	Cr. Wh.	83H	230	800
1— 150	Cr. Wh.	CMC-65H	230	1150
1— 150	Cr. Wh.	CCM-152H	230	300/1000
1— 50/120	G.E.	MCF	230	250/1000
4— 75	G.E.	TLC-59	250	850/2500

FREQUENCY CHANGERS

1—1000	A.C.	25/6234			2300/2300
1—1000	G.E.	25/58	Cycle		4100/2366
1— 500	A.C.	25/60	Cycle		11000/2300V

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse		4150	600
1	3000	Whse.		4800	720

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
2	4000	G.E.	HT	3	22000x2300
3	1250	G.E.	H	1	6600x560
1	1050	G.E.	WCTH	3	11000x445
1	1000	G.E.	HT	3	13200x2300/4600
1	500	Whse.	OISC	1	34650x483
3	333	Maloney	OISC	1	13200x240/480
6	300	G.E.	HT	3	13200x240/480
2	300	G.E.	HT	3	6600x240/480
9	300	G.E.	HT	3	2400x240/480
3	150	Maloney	OISC	1	13200x2300/4600
1	100	G.E.	H	1	450x230

RECTIFIERS

1— 750	G.E.	BHW	575	2300
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
2—2000	Whse.		2300	120
1—1478	Whse.		4600	900
2— 900	Al. Ch.	(New)	2200	150
3— 735	G.E.	ATI	2200/12000	600
1— 650	Whse.	G	2200	138
1— 600	Whse.	Sym.	440	360
1— 450	Whse.	Eng.	2200	128.5
2— 350	G.E.	TS	2200	150
1— 300	Whse.		2300	720
1— 300	Whse.	G	440	900
1— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600

SLIP RING

1—1000	Whse.	CW	2300	444
2— 500	G.E. unused	M-574Y	2200	900
1— 500	G.E.	IP	550	585
1— 500	G.E.	IM-Mill	2200	450
1— 500	G.E.	IM	440	900
1— 350	G.E.	MT-442-Y	2200/4000	353
1— 300	Al. Ch.	3 Brg.	2300	505
1— 300	G.E.	IM	440	720
2— 300	Al. Chal.	ANY	2200	708
1— 250	Al. Chal.	ANY	440	585
1— 250	G.E.	M-567-TEFC	440	600
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 250	Al. Chal	ANY	550	600
1— 200	Al. Ch.	ANY	440	440
1— 200	G.E.	MTF	440	1170
1— 150	G.E.	IM-15	440	885
1— 150	Al. Chal.	ANY	440	580
4— 125	G.E.	MT-566Y	440/2200	435
4— 100	G.E.	MT-566Y	440/2200	425
1— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
3— 100	Al. Ch.	ANY	440	695
1— 100	G.E.	MT-556	2200	900

SQUIRREL CAGE

2— 650	G.E.	FT5593Y	440	3570
2— 450	Whse.	CS	2300/4150	884
1— 200	G.E.	IK-17	440	884
1— 200	G.E.	KT-557	440	1800
1— 300	G.E.	KT-574Y	2300	595
1— 200	G.E.	IK-17	440	580
1— 150	Wstghse.	CS854S	440	880
1— 125	Whse.	MS	440	435
1— 125	(New) G.E.	KP-TEFC	440	1190
1— 125	G.E.	KP-TEFC	440	3585
3— 125	Al. Ch.	ARW	2200	1780
1— 125	G.E.	IK	220	900
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750
1— 100	G.E.	KT-556	440	1490

RE NU BILT BELYEA MOTORS

BELYEA COMPANY, Inc.

43 HOWELL ST., JERSEY CITY, N. J.

PHONE - JOURNAL SQUARE 2-3334

N. Y. LINE - RECTOR 2-7150

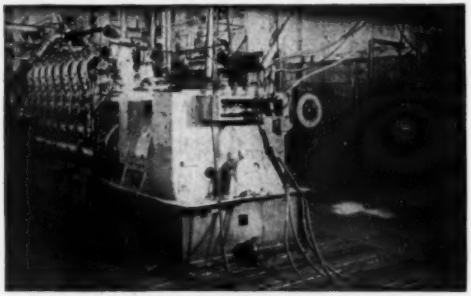
DIESEL POWER

AT 40% TO 60% SAVINGS

EACH ENGINE "REMANUFACTURED"
AND "FULL-LOAD TESTED"
PRIOR TO SHIPMENT

INSPECTION INVITED

ALL EQUIPMENT OFFERED WITH ONE YEAR GUARANTEE



VIEW OF ENGINE TEST STAND FACILITIES AT OUR PLANT IN SAUSALITO (S.F.) CALIF. ALL ENGINE TESTING CONFORMS TO DIESEL MANUFACTURERS' STANDARD METHODS.

A PARTIAL LIST OF OUR INVENTORY

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33E16	2000	300	312.5	General Motors	8-268A	450	1200
1420	Fairbanks Morse	38D	1600	720	312.5	Clark	GD-4	375	327
1250	General Motors	16-278A	1600	720	300	Fairbanks Morse	YVA	360	257
1000	General Motors	12-278A	1200	720	250	General Motors	8-268A	350	1200
937.5	General Motors	12-567	1080	720	237	Ingersoll-Rand	S	255	600
625	Alco	6-12½x13T	750	600	200	Buckeye	80	240	600
625	General Motors	8-567	720	720	156	Buckeye	E	190	400
425	Baldwin	VO	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	75	General Motors	6-71	90	1200
375	Enterprise	DSG-6	450	450	62.5	Int'l Harvester	UD-18	76	1200
330	Superior	KNA	396	514	50	General Motors	4-71	60	1200

A. G. SCHOONMAKER COMPANY, INC.

52 CHURCH STREET, NEW YORK 7, N. Y.

SHOPS AND WAREHOUSE: JERSEY CITY, N. J. AND SAUSALITO (S.F.) CALIFORNIA

NORTHERN METAL CO.

MACHINERY at REDUCED PRICES

BOILER

Water Tube. Babcock & Wilcox, 1945. 2 Drum, Bent Tube, Economisers, Internal Desuperheater. Superheaters: W.P. 400 P.S.I. Hydrostatic Press. 718 P.S.I. Heating Surfaces: 2441 sq. ft. Superheater 350 sq. ft. Economiser 1620 sq. ft. 3 Todd "Hex Press" Fuel Oil Burners. Diamond Soot Blowers. Auxiliaries available.

BOILER

Mfr. Vancouver Iron Works, Vancouver, B. C. Type: Yarrow, 3 Drum, Bent Tube, Water Tube, Oil fired, 4 Burners, 55,000 lbs. steam per hr. Max. Heating Surface 6256 sq. ft. Working Press. 225 P.S.I. Test Press. 337 P.S.I. Built 2/7/43.

NUMEROUS OTHER ITEMS ARE AVAILABLE

MILNOR & BLEIGH STS. • PHILA. 35, PA.

Phone MAyfair 4-1400

COMPLETE DIESEL PLANT

3—575 HP F.M. 5 cylinder, 400 RPM. 383 KW F.M. 3/60/2300 alternators. Woodward governors, heat exchangers and complete plant auxiliaries. For sale in whole or part. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

POWER PLANT

Eight (8) 524 H.P. each, B. & W. sectional header type, A.S.M.E., 200# with pulverized fuel equipment, coal conveyor, etc. Will separate. Immediate inspection and delivery. Location, Philadelphia district.
300 H.P. International Brady scotch type, A.S.M.E., 150#.

Two (2) 84" x 18' Erie City HRT-A.S.M.E., 125# press.

M. J. HUNT'S SONS
1620 N. Delaware Avenue
Philadelphia 25, Pa.

WORLD'S LARGEST INVENTORY

Established 1934 — D & B Rated

ELECTRIC EQUIPMENT CO., ROCHESTER, N.Y.—JUNE BULLETIN

MOTOR GENERATOR SETS
AC — DC

Quan.	KW	Make	Volts
1	1000	General Electric	250
6	1000	General Electric	600
1	750	Allis-Chalmers	250
2	500	Westinghouse	250
2	500	Westinghouse	1500
1	500	Westinghouse	125
1	400	Westinghouse	125/250
2	300	General Electric	125/250
1	300	General Electric	500
1	250	General Electric	250
1	200	Westinghouse	250
1	200	General Electric	250
2	200	General Electric	125
1	150	General Electric	250
1	150	General Electric	125
3	100	General Electric	125
4	100	General-Electric	250
1	100	Allis-Chalmers	125/250

Plus 238 sets from 1 KW to 75 KW in stock.

DC TO AC

Input		Output
1	300 HP—230 V	200 KW, 440/60/3
1	125 HP—230 V	75 KW, 125 V, DC
1	25 HP—230 V	15 KW, 230/60/3
1	25 HP—230 V	15 KVA, 230/60/1
35	20 HP—230 V	12½ KVA, 440 V, 3 ph. .5 P. F.
40	7½ HP—230 V	7½ KVA, 120/60/1
20	6 HP—115 V	5 KW, 120/60/1
5	3 HP—115 V	2 KVA, 110/25/1
10	1½ HP—115 V	1 KVA, 110/60/1
10	1 HP—115 V	½ KVA, 110/60/1

ROTARY CONVERTORS

Quan.	KW	Make	Speed	Volts
5	500	General Electric	1200	250
7	400	Westinghouse	1200	250
1	100	General Electric	1200	250

P.S.—We Stock Explosion-Proof Motors—Class 1-D & 2-G

AC GENERATORS
ALTERNATORS—CONDENSERS

Quan.	KVA-HP	RPM	CYCLE
1	2500	720	60
1	2500	900	60
2	1675	600	40
2	1500	900	60
1	1430	514	60
1	1250	1200	60
1	1000	750	25
1	800	900	60
3	750	900	60
2	650	139	60
1	500	720	60
1	500	750	25
1	400	450	60
3	400	1800	60
1	350	750	25
1	350	720	60
1	350	225	60
1	333	1800	960
1	320	1200	120
1	300	750	25
1	300	180	60
1	250	720	60

Plus 78 smaller units from 3 KVA to 200 KVA

60 CYCLE MOTORS
SQUIRREL CAGE MOTORS

HP	SPEED	MAKE
500	720	G. E.
400	1200	West.
400	514	West.
300	600	West.
250	3600	G. E.
250	1200	G. E.
200	600	Al. Ch.
200	1800	Wagner
150	720	G.E.
150	600	G. E.
150	1200	Al. Ch.
150	1800	Al. Ch.

P.S. We stock 3500 new and rebuilt 1 HP to 100 HP

SLIP RING MOTORS

Quan.	HP	Speed	Make
1	600	1800	G. E.
1	500	1800	G. E.
1	500	514	Al. Ch.
4	500	900	G. E.
1	350	720	G. E.
1	300	450	G. E.
1	300	514	G. E.
1	300	900	G. E.
1	300	720	G. E.
1	200	600	G. E.
1	200	1200	G. E.
2	150	720	G. E.
1	125	1200	Al. Ch.
1	100	900	Wagner
4	100	450	G. E.
3	75	720	West.

Plus 837 smaller units 1 HP to 40 HP

WANTED

3—200 KVA Transformers, 2400/240/480.
1—1500 KW, 250 volt motor generator set.
1—400 HP, 2300/60/300 rpm slip-ring motor.
1—2000 ampere, three pole air circuit breaker.

Note: We Stock 6000 New Motors, Controls, Frequency Changers
SEND US YOUR INQUIRIES!

TRANSFORMERS

Quan.	KVA	Primary Volts	Secondary Volts	Phase
2	3000	23,000	2300	3
1	1500	2,300	600	3
1	1000	2,300	220	3
6	1000	66,000	7200	1
3	750	2,400	480	1
6	500	2,400	480	1
3	500	12,000	2300	1
3	450	23,000	440	1
3	333	2,400	600	1
3	333	2,400	240/480	1
3	333	13,200	240/480	1
3	333	11,500	240/480	1
3	300	2,400	120/240	1
6	250	2,400	240/480	1

Plus 734 smaller units 1 KVA to 100 KVA

DC MOTORS
ADJUSTABLE SPEED—230 VOLT

Quan.	HP	Make	Volts
1	300	General Electric	400/800
1	250	West.	250/675
4	40/250	West.	540/3000
1	150	West.	300/900
1	100	Reliance	500/1500
1	100	G. E.	400/1000
1	100	West.	450/1350
1	100	G. E.	1050/4000
1	90	F. M.	500/1500
1	75	G. E.	400/1200
1	60	G. E.	220/1000
1	60	G. E.	300/1200
1	50	G. E.	250/1000
1	50	G. E.	400/1200
1	40	G. E.	250/1000
1	40	Cr. Wh.	400/1600
1	35	West.	250/1000
1	35	G. E.	500/1000
1	30	Reliance	400/1200
1	30	Cr. Wh.	500/1500
1	25	Reliance	400/1600

Plus 327 smaller units 1 HP to 30 HP

CONSTANT SPEED—230 VOLT

HP OR KW	MAKE	SPEED
400 HP	Elec. Dyn.	1500
300 KW	G. E. (170 V)	1200
300 HP	Cr. Wh.	1200
250 KW	Al. Ch.	720
150 KW	West.	720
125 HP	Star	1200
100 HP	G. E.	900
75 HP	G. E.	1200
75 KW	G. E. 325 V	1200
50 HP	West.	1200
50 HP	Burke	1800

Plus 675 smaller units 1 HP to 40 HP also 115 V & 550 V, DC.

SQUIRREL CAGE AND SLIP RING—25 CYCLE

Quan.	HP	Speed	Make
1	650	365 rpm	S.R.
1	350	750	S.C.
1	300	750	S.C.
1	300	375	S.R.
4	200	500	S.R.
1	200	750	S.C.
1	200	750	S.R.
1	200	500	S.C.
1	200	1500	S.C.

Plus 872 smaller units 1 HP to 150 HP

ELECTRIC EQUIPMENT COMPANY

PHONE LD 65

ROCHESTER, N. Y.

New and Rebuilt MOTORS · MG SETS · TRANSFORMERS · CONTROLS · COMPRESSORS · 1 H. P. to 2500 H. P.

PARTIAL LISTINGS OF EQUIPMENT AVAILABLE FOR YOU

MOTOR GENERATOR SETS

3 Ph. 60 cycle

KW	DC Output	AC Input	Speed	Make
1800	250	2300/4000	600	G.E.
800(3U)	400/600	2300	1200	Whse.
750	500	13200	900	Whse.
300	250	440	1200	Whse
300	250	2200	1200	A-C
300	250	440	900	Whse.
100	250	4300	1200	Whse.
75	125	440	1200	G.E.
50	125	440	1800	C-W
25	230	220	1---	Rel.-G.E.
22	125	220	900	A-C
20	125	220	900	G.E.-A-C
12½	230	220	1800	Whse
10	250	220	1800	Whse.
7½	250	220/440	1800	Whse.
7½	125	220/440	1200	Whse.
5	230	440	1200	Whse.
1	115	220/440	1800	G.E.

ROTARY CONVERTERS

KW	DC Volts	AC Volts	RPM	Make
1700	250	*	514	G.E.
300	600	33000	1200	Whse
150	250	*	1200	Whse.

*Will wind for any voltage

SYNCHRONOUS MOTORS

3 Phase, 60 Cycles

HP	RPM	Volts	Mfr.
3000	720	4800	Whse.
735	600	12000	G.E.
500	514	440	G.E.
435	720	2300	G.E.
430*	750	2300	Whse.
320	900	2300	G.E.
300	1800	2300/4160	G.E.
300	720	440	Whse.
250**	225	2300	G.E.
235	900	4100	G.E.
220	600	2300	G.E.
220	277	2300	Whse.
200**	150	220	G.E.
175**	225	220	G.E.
160	600	440	G.E.
160	164	440	G.E.
150	1800	2200	G.E.
150	1200	220	Whse.
150	900	440	Star
150*	300	220	Chandeyson
120**	225	220	E-M
115	164	220	G.E.
115	164	220	G.E.
100	1800	2200	Whse.
100	1200	220	Whse.
95	1200	220	Burke
75	1200	220/440	Delco

*25 cycles.
**Rotor and stator only, engine type.

SPECIAL

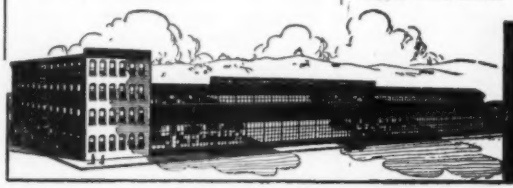
3—G.E. Rectifiers, 500 amp., 6 volt, DC output, 440 Volt, 3 Phase, 60 Cycle input, New Copper Oxide Stacks.

SLIP RING MOTORS

3 Phase, 60 Cycles

HP	RPM	Volts	Mfr.
500	900	440	G.E.
500*	900	2200/4160	G.E.
375	1800	2300	A-C
350	514	220/440	G.E.
300	1200	440	Whse
300	720	2200	A-C
300	600	440	G.E.
250	600	440	A-C
250	300	2200	A-C
235	1800	220	G.E.
200	1800	440	A-C
150	1800	440	G.E.
150	900	2200	A-C
150	720	440	G.E.
150	600	440	A-C
100	1200	440	Whse.
100	720	440	A-C
100	400	440	G.E.
75	720	440	A-C
75	600	440	A-C
60	1800	230/440	A-C
50	900	440	A-C
50	1200	220	F-M
50	900	440	Whse.
50	720	440	A-C
45	1200	440	Whse.
40	900	220	A-C
40	720	2200	A-C
40	600	220	G.E.
40	450	220	Triumph

*New.



GLOW ELECTRIC CO.
927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

TRANSFORMERS

FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/ SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. Philadelphia 20, Pa.

FOR SALE
GENERAL MOTORS DIESEL

Model 12-567, 900 H.P. at 720 R.P.M. complete with heat exchanger, muffler and Watson Flagg reverse gear—all like new. May be seen in storage at Nekoosa Edwards Paper Company, Nekoosa, Wisconsin. *Contact Mr. E. P. Gleason.*

Price $12,000.00

PORTER ELECTRIC CO.
116 3rd Ave. No., Minneapolis 1, Minn.
Lincoln 7531
When you can't find it try Porter.

Most all units still on foundation. Many may be seen operating

DIESEL UNITS

240/440/2300 Volts

1000 KVA Elliott-De LaVergne
300 KVA Fairbanks Morse
250 KVA GE-Buckeye
210 KVA (2) Wghse.-Buckeye
200 KVA Fairbanks Morse
187 KVA GE-Buckeye
75 KVA (2) General Motors
50 KVA (2) Fairbanks Morse
225 HP Buckeye (belted)

TURBO GENERATOR UNITS

Condensing—Bleeders

3750 KVA Wghse. 3/60/600 V. (Bleeder)
2500 KVA GE 3/60/600 V. Cond.
1625 KVA Wghse. 3/60/2300 V. (Bleeder)
1250 KVA Wghse. 3/60/2300/4150 V. (450#)
1250 KVA GE 3/60/480/240/600 V. (Bleeder)
937 KVA GE 3/60/600 V. Cond.
750 KVA Al. Chal. 3/60/480/240 V.
625 KVA GE 3/60/2300 V. (Bleeder)
625 KVA Wghse. 3/60/600 V. Cond.
375 KVA Wghse. 3/60/240/480 V. Cond.

TURBO GENERATOR UNITS

Non-condensing

375 KVA (2) Al. Chal. 3/60/240/480 V.
250 KVA GE 3/60/2300/600 V.
187 KVA GE 3/60/480/240 V. 375# 65-165# bp
156 KVA Al.-Chal. 240/480 V.
125 KVA GE 3/60/240/480 V.
62 KVA GE-DeLaval 240/480 V.

STEAM ENGINE SETS, A.C.

480/240 Volts

625 KVA GE-28x32 Chase 4 V.
450 KVA GE-Amos Unif. (Cond.)
450 KVA GE-22x28 Chase 4 V.
312 KVA (2) CW-23x24 Skinner Unif.
219 KVA GE-18x20 Amos Unif.
187 KVA Wghse.-Amos Unif. (Vertical)
125 KVA Wghse.—Amos Unif.
62 KVA GE-13x14 Amos Unif.

BOILERS

30,000# B&W type F; 425#
300 HP Cleaver Brooks 150# (New)
427 HP Bigelow, 3 drum, low hd.
333 HP Bigelow, 3 drum, low hd.
332 HP (2) B&W type H 160#
250 HP (3) Erie City HRT 150#
220 HP (2) Vogt 3 Dr. Low Hd. 160#
200 HP Erie City self contained 160#
150 HP Farrar 2 pass, Orsbox, 150#
150 HP (3) Murray, low Hd. 250#
150 HP Scotch Marine, 150#
125 HP Keeler Economic, 125#

Above listed units are only a few of our "SPECIALS." Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—12500 KVA Allis Cond. 60 cy. 13800 V. 300-lb.
—10000 KVA G. E. Cond. 25 cy. 6600 V. 200-lb.
1— 5000 KVA West. Extr. Cond. 60 cy. 480 V. 185-lb.
1— 3750 KVA G. E. Cond. 60 cy. 2300 V. 185-lb.
1— 3125 KVA G. E. Cond. 60 cy. 2300 V. 185-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb. BP
1— 2500 KVA G.E. Extr. Cond. 60 cy. 480 V. 185-200 lb. steel valve chest.
2— 2250 KVA G. E. Cond. 60 cy. 240-480 lb.
1— 1875 KVA G. E. Cond. 2300 V. 60 cy. 180-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200-lb.
2— 1250 KVA Elliott Cond. 60 cy. 480 V. 150-200 lb. 800 Surface Condenser
1— 938 KVA G. E. Extr. Cond. 60 cy. 240 V. 200 lb.
1— 750 KVA G. E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA G. E. N-Cond. 60 cy. 2300 V. 180-lb. 35-lb. BP
1— 875 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. BP

DIESEL ENGINE UNITS

2—1400 HP Fair. Morse 2400 V. 60 cy.
1— 900 HP Amer. Loco. 250 V. DC
1— 850 HP Amer. Loco. 440 V. 60 cy.
2— 800 HP Amer. Loco. 250 V. DC
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 250 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS

1—312 KVA Skinner Uniflow 480 V.
1—250 KVA Ames Vertical Uniflow 480 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

ROTARIES—60 CY.

QU.	KW	MFR.	VOLTS-DC	TRANS.	RPM
1	3250	G.E.	225/285	13800	300
1	2000	A.C.	600	4150	514
2	1000	West.	600	4150	720
3	1000	G.E.	600	13200	900 Auto.

MERCURY ARC RECTIFIERS

QU.	KW	KIND	DC VOLTS	TRANS.
2	4500	Multi Anode	600	13800
4	3250	Ignitron	650	33000
2	1650	Ignitron	360	33000
1	1000	Ignitron	600	13800

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	VOLTS-D.C.	A.C.	RPM
1	1500	G.E.	250	2200	514
1	1000	G.E.	600	13200	514
1	750	A.C.	275	440	720
1	750	A.C.	250	2300	514
1	500	West.	125	2300	720
1	400	G.E.	250	6900	720
1	75	Star	240	440	1200
1	75	West.	125	440	1200

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	2500	G.E.	2400/4160	720
1	2000	West.	2300	720
1	1500	G.E.	4600	900
1	1500	West.	2300	900

SYNCHRONOUS MOTORS—60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
1	1000	E. Wh.	2400	720
2	700	West.	2300	200
1	600	G.E.	440	360
2	350	G.E.	2300	257
1	300	G.E.	2300	600
1	300	West.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	3125	G.E.	25/60	300
1	3000	G.E.	60/25	300
2	2500	G.E.	25/62½	750
1	2450	G.E.	62½/25	750
1	1250	G.E.	25/60	300
1	1250	West.	25/60	300
2	1000	G.E.	25/60	600
1	500	A.C.	25/60	300

TRANSFORMERS—60 CY.

1— 7500 KVA G.E. 138000—41000, 3 ph.
3— 3333 KVA West. 132000—7620/13200 Y
1— 2000 KVA G.E. 66000—13800/23900, 3 ph.
3— 1000 KVA West. 66000—7200
1— 500 KVA G.E. 66000—2400
1— 2500 KVA G.E. 69/73 KV—5 taps, 3 ph.
3— 75 KVA G.E. 44000—2300/4600
3— 8333 KVA West. 43800—13800
1— 8667 KVA G.E. 38100/66000 Y—12700/22000 Y/13200
3— 100 KVA Wag. 36000—7200/12470 Y
1—18750 KVA A.B.B. 34840—11000, 3 ph.
2— 7500 KVA At. Ch. 33000—13800, 3 ph.
1— 200 KVA G.E. 33000—2300/6900
1— 167 KVA G.E. 33000—2300/4000 Y
1— 150 KVA G.E. 34500—2300/4600
1— 150 KVA G.E. 33000—7200/12470
1— 75 KVA Wal. 33000/16500—2380/6900
3— 75 KVA Wag. 33000—7200/12470 Y
6— 50 KVA G.E. 31000—2300
1— 4500 KVA G.E. 27000—2300, 3 ph.
1— 7500 KVA G.E. 26400—612, Rectifier Type
3— 3750 KVA West. 26400/15200—2400
1— 450 KVA At. Ch. 25410/44000—13200/23000
3000 KVA G.E. 22000—480, 3 ph.
1— 2000 KVA G.E. 22000/11000—2300, 3 ph.
1— 1000 KVA G.E. 22000/11000—2300, 3 ph.
833 KVA G.E. 22000—480
333 KVA G.E. 22000/11000—2400
750 KVA Wag. 19050/33000 Y—6900/11950
3— 750 KVA West. 13200—440
1— 333 KVA G.E. 13200—240/480
1— 200 KVA G.E. 11500—220/110
3— 200 KVA Wal. 11000—2300
1— 833 KVA G.E. 7620/13200 Y—2300
1— 500 KVA G.E. 4000—2300
3— 750 KVA G.E. 2300/4160 Y—1386/2400 Y Auto
3— 200 KVA A.C. 2400—120/240
3— 100 KVA Kuhl. 550—220/110
12— 15 KVA Stand. 450/225—117/234

OIL CIRCUIT BREAKERS

4—600 A. 154 KV G.E. FHKO-39-2500 Outdoor
1—600 A. 132 KV G.E. FHKO-69-1500 Outdoor
2—600 A. 73 KV G.E. FHKO-138-1000 Outdoor
1—400 A. 73 KV G.E. FHKO-236-500 Outdoor
1—600 A. 37 KV G.E. FHKO-138-450 Outdoor
1—400 A. 37 KV G.E. FHKO-236-500 Outdoor
4—600 A. 15 KV G.E. FKHO-139-750 Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, WOrth 4-1470

TRANSFORMERS—60 CYCLE

SINGLE PHASE

4—3333 KVA., Westgh. 132,000—7620/13200Y
3— 100 KVA., G.E. 44,000—2300
3— 300 KVA., G.E. 33,000—2300/4000Y
6— 200 KVA., G.E. 33,000—2300/6900
1— 25 KVA., Westgh. 33,000—2300
3— 250 KVA., Westgh. 22,000—2300/4000Y
3— 750 KVA., Westgh. 13,200—440
3— 100 KVA., Moloney 13,200—240/480
3— 75 KVA., G.E. 13,200—240/480
4— 75 KVA., G.E. 13,200—440
3—37½ KVA., G.E. 13,800—230/115
3— 150 KVA., Moloney 7620/13200Y—120/240
3— 75 KVA., Moloney 7620/13200Y—120/240
2— 75 KVA., G.E. 4160/7200Y —120/240

TYPE STQ.

2— 30 KVA., G.E. 2200 —100/122

THREE PHASE

1—2000 KVA., G.E. 69,300—13800/23900Y
1—7300 KVA., G.E. 33,000—13800
1— 250 KVA., G.E. 2300/4000Y—575

60 CYCLE MOTORS

1—250 H.P., G.E., slip ring, 3 ph., 60 cy., 2400 volt, 1800 RPM, two bearing self contained, with shaft for coupling.

2—50 H.P., G.E., slip ring, Type MT 356, 3 ph., 60 cy., 440 volt, 600 RPM.

ARCHER & BALDWIN, INC.
75 West Street New York 6, N. Y.
Tel: BO. 9-9275-9276

IN STOCK FOR IMMEDIATE SHIPMENT

NEW and REBUILT MOTORS

3 PHASE, 60 CYCLE, 220 or 440 VOLTS UNLESS OTHERWISE NOTED

HP.	MFG.	RPM	TYPE
1250	G.E.	1800	IM-2300 v*
1000	G.E.	1200	IM-2300 v*
700	West.	300	CW-2300 v*
600†	G.E.	750	IM-2200 v*
400	Cont.	1200	NZ-805
250	G.E.	1800	IM-2300 v*
200	G.E.	600	IM-2300 v*
200	G.E.	1200	IM-2200 v*
200	G.E.	600	KT
150	G.E.	514	KT 568
125	West.	180	IIR-2200 v**
125	G.E.	450	KT
100†	G.E.	750	IM-2200 v*
75	Ridgeway	720	*
60	Lincoln	900	IXM*
60	G.E.	1200	TEFC
60	West.	1800	445, BB
50	A-C	900	ABCT-TEFC

HP.	MFG.	RPM	TYPE
50	G.E.	900	KG 504 (5)‡
50	G.E.	1200	KG 445 (3)‡
50	G.E.	1200	K 504,TEFC
50	West.	3600	CS 405
40	G.E.	900	KG 445 (2)‡
40	G.E.	900	KT 342
40	A-C	900	TEFC
40	G.E.	1200	KT
40	G.E.	1200	KG,TEFC-XP
40	West.	1800	CS
30	G.E.	1200	KG 405 (4)‡
30	West.	1200	CS 405
30	G.E.	1200	TEFC-XP
30	G.E.	1800	K 365
25	G.E.	1200	FT 522
25	West.	1200	CS 556 C
25	G.E.	1800	FT 503
25	West.	3600	CS 364, Sp

HP.	MFG.	RPM	TYPE
20	West.	1800	CS 361
15	G.E.	720	KT
15	G.E.	900	K 365
15	G.E.	1200	KT 302
15	Baldor	1200	TEFC
15	G.E.	1800	K 326
15	G.E.	3600	KF 324
10	G.E.	900	KG365,TEFC
10	G.E.	1200	TEFC-XP
			(Brake)
7½	G.E.	900	K 326,TEFC
7½	Lima	1200	RS 324 (15)‡
7½	G.E.	1800	K 284
5	L-A	900	OGX324(22)‡
5	G.E.	1200	K 284, Splash
5	L-A	1200	OQWE 284
5	Cent.	1800	TEFC-XP
5	G.E.	1800	K 254
5	G.E.	3600	TEFC-XP

* slip-ring ** synchronous † 25 cy. ‡ New

WRITE, WIRE, OR PHONE YOUR REQUIREMENTS
THIS IS A PARTIAL LISTING
WE PAY CASH FOR YOUR SURPLUS

PREFERRED *Electric Motors Inc.*

230 HUDSON AVE., P.O. BOX 767 • ROCHESTER 3, NEW YORK

MOTORS — M. G. SETS — TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1	400	G.E.	IK	2200	514
1	400	G.E.	KT-412	2200	435
2	300	Whse.	CS-890	2300	1780
1	250	Whse.	CS	2200	1160
1	200	Whse.	CS-873C	2200	1160
1	200	Al.Ch.	AR	440/220	580
2	125	Al.Ch.	AR	2200	1750
1	125	Whse.	CS-761C	440/220	1750
1	125	C.W.	126-Q	440/220	430
2	100	Whse.	CS-663C	440/220	1750
1	100	G.E.	IK	440/220	1800
1	100	Al.Ch.	AR	2200	1160
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H241B	440/220	435
1	100	Whse.	CS-938	2200	495
1	75	G.E.	I-K15	440/220	570
1	75	Al.Ch.	AR	2200	1765
1	75	Al.Ch.	AR	2200	1750
1	75	Al.Ch.	AR	2200	690
1	50	G.E.	KT	440/220	1160

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	PF	Volts	RPM
1	3000	Whse.	80	4800/2400	720
1	700	G.E.	80	2300	720
1	600	Whse.	80	2400	720
1	400	Whse.	80	440	600
1	300	Whse.	80	440	514
1	268	Al.Ch.	100	2200	900
1	150	G.E.	100	2300	900
1	150	G.E.	100	550/2200	600
1	150	G.E.	80	550/2200	450
3	125	El.Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900
2	100	Whse.	80	440/220	1800
1	100	Whse.	100	2200	1200
1	100	Ideal	80	220/440	900
2	100	G.E.	80	220/440	600

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1**	3000	G.E.	MT	2200	356
1**	1200	C.W.	SR	2200	237
2**	1000	Al.Ch.	ANY	2200	235
1**	600	G.E.	MT-20	2200	360
1	500	Whse.	C.W.	4600/2300	514
1	500	Al.Ch.	ANY	4000/2300	514
1**	400	G.E.	IM	2300	590
1**	400	Al.Ch.	ANY	2200	514
2	500	G.E.	I-16-M	2300	450
2	400	G.E.	MT-412	2200	450
1	300	G.E.	I-15-M	2300	1200
1	300	Al.Ch.	ANY	2200	514
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	585
1	150	G.E.	I-13-M	2200	1750
1***	125	Whse.	CW-870	2200	870
1	100	F.M.	H20C	440/220	900
1	75	G.E.	IM	440/220	695
1	75	Whse.	CW-7540	440/220	690

**Mill type pedestal bearing. ***3 bearing.

MOTOR GENERATOR SETS

Qu	KW	Make	RPM	Volts DC	Volts AC
1	2400(34)	Al.Ch.	720	525	4800/2400
1	2400(34)	Whse.	720	600	4800/2400
1	1500	Whse.	514	250	4600/2300
2	1000	G.E.	514	575	4000/2300
1	500(34)	Whse.	1200	120/240	2300/440
2	500	C.W.	720	575	4000/2300
1	500	C.W.	720	250/275	4000/2300
1	500	C.W.	720	250/275	2300/440
1	350	G.E.	720	250	2300/440
1	200	Ridgway	900	250	2300
1	155	G.E.	720	250	2300/440
1	150	Al.Ch.	1200	250	2300/440
1	150	G.E.	1200	500	2300/440
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	2300/440
1	75	Star	1200	230	440/220
1	75	Al.Ch.	900	250	2300
1	50	Burke	1800	240	440/220
1	30	Reliance	1800	250	440/220
1	25	Whse.	1200	120/240	440/220
1	20	Reliance	1800	250	440/220

(34—3-unit set.)

TRANSFORMERS (Power)

Qu	KVA	Make	Type	Phase	Voltage
1	7500	G.E.	H	3	33000/29700–13800/12600
1	4500	G.E.	HT	3	27000/24300–2300
3	1500‡	Gregory	(X)	3	4160–480
2	750‡	Gregory	(X)	3	4160–480
3	250	Packard	OISC	1	13200–2200
3	130	G.E.	H	1	19000/9500–550/2200
3	100	Whse.	SS	1	12975/10955–230/460
3	100‡	G.E.	HS	1	14400/12870–240/480
3	50	Al.Ch.	OISC	1	22000–220
2	50	Wagner	HE	1	13200/11880–575/287
3	50	Fenna.	OISC	1	2400/4160-Y-120/240

(X) New, selfcontained, indoor type, air cooled.

DIRECT CURRENT MOTORS

Qu	HP	Make	Type	RPM
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1500	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	350	G.E.	CD-169	1150
1	235	Whse.	QM-6604.6	450/900
1	200/250	El.Dy.	422	400/1200
1***	200	G.E.	MPC	500/1200
1	200	Whse.	MIII	300/1200
1	300	Whse.		240/300
1	180	G.E.	MPC	400
2*	150	C.W.	83-H	800
1***	125	Whse.	SK-190	600
1	100/125	Rel.	1995-F	300/1200
2	100	Rel.	1050-T	400/1200
1	90/160	G.E.	MPC	625/1125
1*	50/75	Rel.	1995-F	300/1200
1	35	G.E.	RF-14	500/1500
1	35	G.E.	CD-125	400/1200
1	35	G.E.	CD-147	300/1200
1	35	Rel.	35P	250/1000
1	32½	Whse.	SK-150	400/1200
1*	30/75	Whse.	SK-151L	400/1200
1	30	Al.Ch.	E-145	400/1200
1	30	G.E.	CDM-105	875/1750
2	27½	El.Dy.	158	450/1350
1	25	G.E.	RF-13	400/1600
1	25	G.E.	CD-123	400/1200
1	25	Whse.	SK-140	400/1200
1	25	Whse.	SK-111L	250/1000
2	20	Al.Ch.	E-130	400/1200
3	20	G.E.	CD-123	300/1200

All above 230-VDC except where marked ***.
*** Pedestal bearing mill design 525/600-VDC.
(Rev.) Designed for mill reversing service.
* T.E.F.C.

T. B. MAC CABE COMPANY

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SPECIAL OFFERINGS

TURBO-GENERATORS

2—4000 KW, 2300 V., 150# Cond.
1—3500 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
2—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 250# Cond.
1—1000 KW, 4150 V., 200# N.C.
2—1000 KW, 480 V., 180# Cond.
1—1000 KW, 480 V., 150# Cond.
1— 750 KW, 550 V., 170# Extr.
1— 750 KW, 2300 V., 175# Extr.
1— 500 KW, 2300 V., 170# Extr.
1— 300 KW, 2300 V., 150# Cond.
1— 300 KW, 2300 V., 200# N.C.
1— 150 KW, 2400 V., 150# N.C.

ENGINE GENERATORS

1—600 KW, 2300 V., Unit.
1—500 KW, 230 V., D.C., Unit.
3—375 KVA, 550 V., Unit.
1—312 KVA, 440 V., Unit.

REFRIGERATION UNITS

3—300 ton motor or turbine driven

BOILERS

2—50,000#, 300#
1—35,000#, 425#
1—25,000#, 150#
2— 500 HP, 200#
3— 500 HP, 400#
1— 438 HP, 250#
2— 400 HP, 150#
1— 150 HP, 150# Sq. Mr.

Write or wire for additional data and prints.

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New and Used Equipment Available for
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BOUGHT AND SOLD
We carry a large stock of transformers, and invite your inquiries.
PIONEER TRANSFORMER REBUILDERS
We rewind, repair and redesign all makes and sizes. *One Year Guarantee.*
THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 — CINCINNATI 27, OHIO

SQUIRREL CAGE MOTORS
50 HP F. Morse 3/60/220-440/1750/TEFC
350 HP C.W. 3/60/2300V/3550 RPM
450 HP G.E. 3/60/2300V/1200 RPM Vert.

SLIP RING MOTORS
500 HP G.E. 3/60/2300V/900 RPM 5275932
600 HP G.E. 3/60/2300V/900 RPM/5165247

SYNCHRONOUS MOTORS—w/CONTROLLERS
125 HP EL. Mach. 3/60/4800V/900 RPM
135 HP G.E. 3/60/4000 V/1200 RPM TS963Z

MULTI-ARC WELDING M-G SETS
24—G.E. 1500 AMP. Synchronous driven (can be rewound for 100 KW DC 240 Volt Output)—w/AC & DC Panels

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ELECTRICAL CABLE
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FOR SALE
1—300 KW, 220 DC Elliott Turbine Generator—A-1 Condition.
W. L. MARTIN, II, Trustee
Box 476 — Bridgeton, N. J.

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS
220/440 volt 3 ph. 60 cy.

Qua.	HP	Make	RPM	Type
1 vert.	250	G.E.	1175	I-2200 v.
1	250	G.E.	1175	I-E 15A (2200 v.)
1	250	G.E.	1175	I
4	250	West.	1775	CS-875a (2300 v.)
1	200	West.	720	CS-954A
1	200	G.E.	860	2200 v.
5	200	Wagner	1750	RP-2
1	175	West.	600	CS
1	175	West.	1200	MS
1	200	G.E.	1800	Syn. (2200 v.)
1	150	West.	257	Syn.
1	150	G.E.	720	I-K
4	150	West.	1150	CS-875a
1	150	West.	1200	MS
1	150	West.	500	CS-954A
1	125	Elec. Mach.	164	Syn.
1	125	West.	450	CS
1	125	West.	600	Syn.
3 New	125	West.	1200	Syn.
1	100	Fair. Morse	300	Syn.
1	75	Stanley	600	
1	75	Elec. Mach.	900	Syn.
1	75	Allis. Chal.	1750	
1	60	G.E.	1800	KT-533
1	60	Triumph	1200	B-133
1	50	Triumph	860	B-133
1	50	G.E.	720	KT-546
1	50	Crocker Whl.	900	
3	50	West.	900	CS
3	50	West.	1200	KS
			1750	k-504 U (2200 v.)
5 New	50	G.E.		AA-504s
2 New	50	Reliance	1750	AA-504s
1	40	G.E.	870	KT-546
3	40	West.	720	CS
1	40	Allis Chal.	1750	Hi-torque —hi-slip
			1630	
1	40	G.E.		—hi-slip
1	40	Allis Chal.	1750	
1	40	G.E.	3600	FT-513Y
			790	KR-444
1	30	G.E.		TEBB
2	30	G.E.	3600	KT-205
1	25	Commonwlth.	580	splash prf.
1	25	G.E.	810	KR-405 hi. torque —hi-slip
2	25/7.5	Continental	1150/575	2 speed
1	25/6.2	Continental	1150/575	2 speed
1	25	Howell	1200	SC
1	25	Reliance	1200	IJ
1	25	G.E.	1200	KF-405
1	25	West.	1150	CS-405
1	20	G.E.	680	KT-532a
1	20/7½	G.E.	1165/425	K-504
2	20	Allis Chal.	860	
1	20	Louis Allis	870	Exp. Pf.
1	20	Allis Chal.	1120	hi-torq.
4	20	Cr. Wh.	1150	SC

SLIP RING MOTORS
3 ph.—60 cy.

HP	Make	RPM	Type	Volts
600	Ideal	1770		440
500	Ideal	1770	AYN	440
400	Westg.	438	HF	2300
300	Allis Chal.	585		2300
200	Westg.	590	CW	220/440
100	Triumph	580	C-17	550/220/440
75	G.E.	450	M-8335	220/440
60	Westg.	1160	CW-644C	220/440
60	G.E.	870	MTC-8348	220/440

SPECIAL BARGAINS
Diesel Engine Generator Sets

10—100 kw., 120/240 v. D.C. Deisc Generators dir. con. to 150 HP Model GBD-8, 8½x7, 8 cyl. Superior DIESEL Engines, elec. start with engine panels

4—100 KW same as above with 220 or 440 v. NEW A.C. Generators

1—60 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 300 rpm DIESEL

4—25 kva. 120 v. 1 ph. 60 cy. Westinghouse dir. con. to 55 HP., 4 cyl. 900 rpm., LeRoi Gasoline Engines with control panels.

5—25 kw., 220/440 v. 3 ph. 60 cy. Westinghouse direct connected to 4 cyl. LeRoi Gasoline valve in head liquid cooled Engine complete with control panels

3—2½ kw. NEW 115 v. 1 ph. 60 cy. Leland belt driven by Briggs & Stratton air cooled gasoline engines complete with fuel tank and muffler all mounted on steel skids.

NEW EXPLOSION PROOF MOTORS

2—3 HP., 1750/3500 rpm 230 V D.C. Reliance.
3—7½ HP., 1750/2190 rpm 230 V. D.C. Reliance.

NEW SINGLE PHASE MOTORS
110/220 v. 60 cy.

15—¾ HP G. E. 1145 rpm type KCJ-304, drip proof.
8—1¼ HP Westg. 1725 rpm B.B. Type CAF-204.
8—2 HP Westg. 1160 rpm type CU-254.

CRANES

1 ton Euclid Overhead 29'6⅝" span, 8' lift, 220/440 v. 3 ph. 60 cy.
1 ton Euclid Overhead 29'10⅛" span, 8' lift, 220/440 v. 3 ph. 60 cy.

GEARHEAD MOTOR

1—NEW 16 Hp., Westinghouse 220 v. 3 ph. 60 cy. 1200 rpm., to 20 rpm type FD-326F, frame W326 type CS

STEARNS BRAKES

6—Size 1306-C Stearns Magnetic Disc Brakes 220 or 440 volt 345' lbs.
1—525# ft. torque General Electric 230 v. D.C. Magnet Brake, sh. wd. CR-9323 100 to 125 HP
1—900 lbs. per ft. series brake, drum made for tapered shaft, type M, size 18, torque, 1135 rpm., 230 v. line volts, drum 18" dia. 6¾" face, Cutler Hammer Magnetic clutch.

MOTOR GENERATOR SETS—
250 V. D.C.
Motors 220/440 volt or 2200 volt

No.	KW	Make	Rpm
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Deico	1200

TRANSFORMERS
1 ph. 60 cy.

No.	Kva	Make	Primary	Sec.
3	500	West	22000	2300
3	200	Pgh.	22000	2300
3	200	Pgh.	4600	230/460
5	200	Allis Chal.	4800	230/460
2	150	Pgh.	4800	115/230
1	110	Pgh.	4800	115/230
6	100	Pgh.	4600	115/230
2	100	Allis Chal.	4800	230/460
2	100	O. E.	4800	230/460
1	75	Pgh.	4600	115/230

ENGINES

NEW 75 HP. P.&H. Model 337C 3 cyl. Diesel
Rebuilt 32 HP. Caterpillar Model D-3400 Diesel
NEW 43 HP. International Model U-6 4 cyl.

NEW AXIAL FLOW VENTILATING FANS

20—6000 cfm Sturtevant Bulletin 512389 3" stat. pres. 7 blade dir. con. 5/1.5 HP 1765/1178 rpm 220/440 v. 3 ph. 60 cy. Westg. TEPC Motors
5—5000 cfm 3.2" stat. pres. Sturtevant with 2 speed 220/440 v. 3 ph. 60 cy. Motors
2—10,000 cfm LADEL dir. con. 2 speed 220/440 v. 3 ph. 60 cy. Motors
1—12000 cfm 3" stat. pres. with 2 speed 220/440 v. 3 phase 60 cy. Motors
2—16000 cfm 3" stat. pres. Buffalo Forge with 2 speed 220/440 v. 3 ph. 60 cy. Motors

AUTO TRANSFORMER

3000 kva. output 22000 Y to 2300 v. 3 ph. General Elec.

BAKER LOCOMOTIVE CRANE TRUCK

Model CYA 3000 lbs. at 7' radius with 8 to 12' adjustable telescoping boom complete with slow control, hoist control and boom control.

SPECIAL BARGAIN
550 V. M.G. Sets

2—500 kw. Crocker Wheeler 575/900 v. 720 rpm., dir. con. 4160 or 2300 v. 3 ph. 60 cy. Syn. Motors with swbds.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

EQUIPMENT FOR SALE

2—500 hp straight tube W.T. Boilers 165 psi. Detroit U. F. stokers.

1—Nordberg Uniflow engine, 18 x 24 direct connected to a-c generator 200 kw 240/3/60.

1—Filer & Stowell 24 x 42 Corliss 100 rpm with 12 ft. x 41 in. belt wheel. 100 ft. 3 ply 30 in. leather belt like new.

2—Duplex Steam B. F. pumps.

3—Oil switches—Condit Electrical Mfg. Co. Boston. Type D17A Max volts 15,000 —400 amps.

3—200 kva 60 cycle 1 phase Polarity sub —Pri Volts 3810, See volts 244-488. GE type H Form C.P. Rebuilt by W. N. Abbertson & Co. Inc. Ser. 554242, 55-4243, 554244.

Westinghouse static condensor, type L.D. Normal operating volts 4000, Max. sustained volts 4400. Normal kva 180 Max. kva 218. 60 cycle 3 phase S.O. 33C808.

32—Capacitors Type LD 5 kva Style 420525.

3—Westinghouse current transformers. Type KA 50 VA 50-5 amps. Comp for 25 VA 8900 V 25-133 cycle Style 180-643A.

Westinghouse hand operated oil circuit breaker. Style 296783B.

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COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

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1—100,000# cap., 350# Steam Gen., 85% efficiency.
2—60,000# capacity 450# Boiler with superheat
1—50,000# Edgemoor 225# Superheat.
2—32,000# ea. cap. 450# Generator, S/heat airheater
2—1000 HP Stirling type Boilers 250#—super
2—650 HP B&W Stirling type Boilers
2—516 HP; 2—315 Heines 165# several 200 HP
3—300 HP B&W Sectional Headers 160#
2—300 HP Heine Cross-Drum 200#
1—Complete 300 HP Boiler Plant, 240# incl. bldg.
1—800 HP B&W Steel Sectional Header Boiler
2—400 HP B&W Steel Sectional Header Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

2—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond. 600#
1— 5,000 KVA Turbo-Generator 450# with condens.
2— 5,000 KW Turbo-Generator—Cond.
2— 3,000 KW Turbo-Gen. and Cond., see aut. extras.
2— 2,500 KW Turbo-Generators and Condensers
3— 2,000 KW Turbos & Condenser
2— 1,500 KW Turbos & Condenser
2— 1,250 KW Turbos & Condenser
2— 1,000 KW, also 750 & 500 KW Units, Condens.
Non-Cond.:—300—500—750—1000—1500—2000

Frequency Changers—Motor-Generators & Diesel-Generators

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SWITCHGEAR and SERVICE PANELS

SERVICING PANEL
48 to 62 cycles
0 to 3000 volts
Synchroscope

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1250 KVA
0 to 1500 Kilowatts Generator
0 to 150 volt Exciter
0 to 400 Amps Generator
0 to 150 Amps Exciter

PANEL NO. 2
0 to 2500 Kilowatts Generator
0 to 150 volts Exciter

PANEL NO. 3
0 to 200 Amps
0 to 100 to 60 Power Factor
Westinghouse Watt Meter and Hour Meter

PANEL NO. 4
0 to 200 Amps
Watthour Meter

PANEL NO. 5
0 to 150 Amps

PANEL NO. 6
0 to 100 Amps—Plant Panel Regulators

Slate Panels and Sheet Angle Iron Frame

Board 9 years old
Copper Buss Bars ⅜" x 3"

Panels No. 1 and 2 have Silver-state voltage regulators and Oil Switch. Panel No. 3 has Westinghouse Regulator Recording Watt meters and Kilowatt hour meters.

Panels 3, 4, 5, and 6 have regulators, Watt Hour Meters and Oil Switches.

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HEMPHILL EQUIPMENT PROVES ITS VALUE

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TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1500	GE	Pyranol	3	4150x220/200
1	1000	GE	Auto	3/3	4150 x 2400
1	500	Kuhl.	OISC	1	4800 x 2300V
3	400	GE	H	1	6900 x 2250V
1	300	Pitts.	ODSC	1	7800 x 440V
1	200	GE	HT	3	2300 x 220
1	200	Whse.	Auto	3/3	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/3	4150 x 2400
1	150	GE	HT	3	4150-120/208Y new
1	150	GE	KS	1	2300 x 230
1	100	Pitts.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Taps
2	100	Newark	Dry	3/3	440 x 220
2	50	Whse.	Interteen	1	2400 x 120/240

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED DC		AC
1	1000	GE	514	600	2300/4150 Sya
1	300	GE	1200	250	2300 Sya.
1	150	GE	1200	125/250	2300 Sya.
1	150	Whse.	600	125	4150 Sya.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El.Mach.	1200	125	4150 Sya.
3	94	GE	1200	60	440 SC
2	75	GE	1200	250	220/440
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
2	40	El.Mach.	1750	125	440 SC

SLIP RING

1	2500	GE	MT	6600	257
1	250	Whse.	CW	440	600
1	300	Whse.	CW	440	600
1	100	GE	IM	440	400
1	75	GE	MT	220	200 Vert
1	75	GE	MT	440	1900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	800
1	40	GE	MT	220	1200
1	40	GE	MT	2200	1200

SPECIAL—Welding Motor Generator Set

1—176 KVA Whse. Welding Gen. Set, 1 Ph. 220V, 800 Amp 57% PF with Slip Ring Motor & Exiter

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PHONE NEW JERSEY—UNION 3-2600

SQUIRREL CAGE MOTORS
3 Phase 60 Cycle

	HP	Make	RPM	Type
1	60	G.E.	720	IK, 220/440, SB
1	75	Whse.	580	CCL, 220/410, SB
1 New	75	Elect. Mach.	500	440, BB
1	100	Whse.	720	CCL, 220/440, SB
1	100	Wagner	1200	TEFC, 440, BB
1	100	Al. Chal.	1800	SYNC. 440, SB

SLIP RING MOTORS
3 Phase 60 Cycle

	HP	Make	RPM	TYPE
1	30	G.E.	850	MT, 220, SB
2	30	G.E.	850	MT, 2300, SB
1	40	Whse.	850	CW, 220/440, SB
1	50	G.E.	1150	IM, 220, SB
1	50	G.E.	1730	MT, 220, SB, Vert.
1	60	C.W.	1740	SR, 220, BB, Vert.
1	60	G.E.	850	MT, 220/410, SB
1	75	Eng.Ltd	1200	220/440, BB, 30 degree
1	125	Whse.	1200	CW, 440/2300, BB

	HP	Make	RPM	Type
1	150	Whse.	450	HF, 220/440, SB
1	150	Whse.	1200	HF, 2300/4000, SB
1	200	Whse.	600	CW, 220/410, SB
1	250	Whse.	1750	CW, 220/440, SB
4	3000	G.E.	120	IM, 2300, SB

SPEED REDUCERS

	HP	Make	RPM
1	350	Whse.	5000/1000
1	350	Whse.	1000/200
1	700	Elliott	4500/1200
1 New	320	Jones	900/180

MISCELLANEOUS

1—350 HP, 5 RPM, Westinghouse, steam turbine, 250# steam, 20# exhaust. With Woodward governor.

2—12000 CFM, 16 Oz., Allis Chalmers, Turbo Blowers, 3-60-440.

1—300 KVA, 257 RPM, 3-60-440, Fairbanks Morse alternator.

40—Misc. motor pump units, 1 to 15 HP.

WM. KECK'S SONS

ELECTRIC MOTOR & ENGINEERING SERVICE

201 N. BLUFF STREET — JOLIET, ILLINOIS

FOR SALE—POWER PLANTS

Allis-Chalmers Steam Engines and Generator, Corliss Type, Valve Gear, Fly Wheel—Complete with Traveling Crane and all Switches and Electrical Boards.

Excellent condition—Used up until 90 days ago in liquidated shoe plant

600 KW every hour
2300 Amp., 8-hour day
600 HP
120 RPM
240 volts no load

Also in same plant, for sale, small power plant, shaftings, and large DC motors.

This plant provided light and power for manufacturing 100,000 pairs of shoes daily in 350,000 sq. ft. of manufacturing space.

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FOR SALE

Complete Boiler Plant with Boiler House

2—406 HP ea. 240# Boilers with stokers, complete coal plant and boiler accessories, including self-supporting stack.

CHARLES B. REARICK

30 Church St. — New York 7, N. Y.

HEINE WATER TUBE BOILER

411 HP 200# ALL NEW TUBES

Can ship in one piece

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WESTINGHOUSE TYPE HQS PHASE SELECTOR RELAYS

For Selective-Pole Carrier Relaying. *Brand New, Complete.* Original cost $650.00 per set. Only 40 sets in stock. Circular available.

$95.00 each

ELECTRO SALES CO., INC.

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190 KVA 440 V. DIESEL GENERATOR

DE LA VERGNE MODEL VE 260 H.P. 6 CYL. 4 CYCLE, 600 RPM, DIR. CON. 190 KVA, 3 PH., 60 CY., 440 V. GENERATOR. COMPLETE SWITCHBOARD ETC. USED ONE YEAR.

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Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

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33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP. 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

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1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

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60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

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100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

MOTORS

250 HP Gen. Electric Synchronous Type ATI 3/25 cycle/2200/500 RPM.

350 HP Westinghouse Slipring Type CW, 3/25 cycle/2200/500 RPM.

400 HP Westinghouse, Synchronous 3/60/2300/900 RPM.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

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3—100 KVA G.E. 1 ph., 60 cy., 2400/4160 pri., 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

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3—150 K.W. DIESEL GENERATOR SETS

Buckeye—600 r.p.m.—medium speed Westinghouse generator — 440/3/60 — complete with modern dead front switch gear. Units equal to new—used only 50 hours.

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¾ to 25	450 to 117
3 to 25	225/450 - 117/234
3 to 25	600 to 120/240
PHASE CHANGERS	
6 to 50	220 or 440 to 220

MANUFACTURED BY ALLIS CHALMERS

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SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500	2300	G.E.	450
450	440/220	Whse.	514
400	2300	G.E.	1200
350	2200/440	G.E.	450
300	440	Whse.	2600
350	440/220	Whse.	600
250	2300/550	G.E.	450
250	550/440	G.E.	1200
200	440	G.E.	450
200	440	G.E.	450
198	4000/2300	G.E.	1800
150	440/220	Whse.	600
150	440/220	Whse. (3)	1800
145	4000/2300	G.E.	1800
125	550/440	G.E.	1200
100	440/220	G.E.	900
100 (3)	440/220	Whse.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2300/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	G.E. Mehy.	Hyn.	600
240	2300/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
150	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2300/440	Whse.	GE	900

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator, dir. conn. to 50 hp. G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37500 V., G.E., Type FHKO-236 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	440	G.E.	FT	3600
500	2300/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
250	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1200
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2300/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2300/440	G.E.	K	1200
75 (5)	550	G.E.	KF	1800

A. C. GENERATORS

1—250 kva. 600 rpm, 2300/440/220 V., G.E.
1—250 kva. 720 rpm, 2300/440 v., G.E.
1—225 kva. 600 rpm, 220/440 v., G.E.
1—225 kva. 720 rpm, 2300/440 v., G.E.
1—150 kva. 900 rpm, 480/240 v., G.E.
3— 75 kva. 1800 rpm. 480/240 v., Whse.
1— 50 kva. 1200 rpm, 440/220 V., G.E.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (3)	G.E.	CD	1150
250	230 (3 new)	Cr. Wh.	CMC	1800
150	230 (3)	Whse.	SK	850
150	230	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 230/440 v., synchronous
1—75/90 kw, 250 V., 1200 rpm, G.E. conn. to 135 hp, 440/230 V., sq. cage
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 130 hp, 2300/440 v., syn. motor.
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/230 V., sq. cage

TRANSFORMERS 60 Cy.

3—333 kva, G.E., 13,200—2300 V.
2—333 kva, G.E., 4600/2300—230/460 V.
3—300 kva, Whse., 13200—440 V.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—250 kva, Whse., 2300—208 V.
3—200 kva, Whse., 13,200—2300 V. (Inertsen)
4—200 kva, Moloney, 2400—230/460 V.
3—150 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3— 75 kva, G.E., 2400—240/480 V.
6—150 kva, Al. Chal. 2400—240/120 v.
1—150 kva, Whse, SK, 13200-132/215 v., 3 ph.
3—75 kva, G.E., 480—240/120 v., Pyranol
3—50 kva, G.E., 480—240/120 V., Pyranol

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1—65,000# per hr.—450# pressure, sectional steel header 4" straight tube type
3—600 HP B&W Vertical forged, steel sectional header 200# pressure.
4—300 HP—B&W—2—500 HP—ditto
1—850 cu. ft.—110#—1500 cu. ft. Motor driven air compressor.

Will purchase entire central station plants for dismantling purposes.
We do our own dismantling.

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TPST OIL CIRCUIT BREAKERS (partial list)

Amps	Volts	Make and Type
400	15000	Gen Elect—FK 132-A & B
600	15000	Gen Elect—FK 132A
400	7500	Gen Elect—FK 35

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2—675 GPM 428' Pumps with 125 HP Turb.
1—200 GPM 556' Pump with 50 HP 3 ph. motor
1—200 GPM 556' Pump with 50 HP Turb.
1—1100 GPM 220' Al.-Ch. Cent. Pump
4—2000-5000 GPM 32'-65', 10" & 12" Pumps
1—1000 GPM 280' all-bronze Cent. Pump
4—Kinney unused 8" Rotary Pumps
3—Blackmer 6" Rotary Pumps 500 GPM
3—750 & 1000 GPM Knowles Steam Pumps
1—6" x 10" & 1—7" x 10" Triplex Pumps
1—3" x 8" Galland Hydraulic Triplex Pump
1—6" x 10" Gardner duplex Pump 300 GPM
1—12" x 14" Duplex Air Compressor 850 CFM
1—12"x10" I-R Air Compressor 355 CFM
2—12"x9" Worth. Comp. 375 CFM, Vac. & Press.
1—4-stage Norwalk Compressor 25 CFM 5000 PSI
1—Sturt. 60 H.P. Tur.-Blower 7000 CFM 20 oz.
1—GE 2-stage Turbo Blower 3000 CFM 16 PSI
1—Spencer 30 H.P. Tur. Blower 4000 CFM 16 oz.
1—60 H.P. DC 230 v. 1150 RPM comp. C-W Motor
1—50 H.P. DC 230 v. 1750 RPM ball.-bear Motor
10—Nash Vacuum Pumps and Vac.-Heating Units
250—Rebuilt Motors 1—200 H.P.
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3-80-4800/2400, dir. conn. to 180 HP BUDA Eng. 6LD-1742 6 cyls. 6½x8¾, gasc. eng. start Mtd. on channel base. Condition Excellent.

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2—500 KVA G.E., OISC, Type H, Form RW, Sub-Tractive Polarity, 4160/7200 Volts Primary, 480 Volts Secondary, 1 Phase, 60 Cycle, 4.5% Impedence Serial #'s 5007062, and 5397672.

1—500 KVA Kuhlman, Type OISC, 1 Phase, 60 Cycle, 4600 Volts Primary, 230/460 Volts Secondary, 6.6% Impedance, Serial #931870.

1—500 KVA G.E., Type A, 1 Phase, 60 Cycle, 4600 Volts Primary, 460 Volts Secondary, Serial #1242264.

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10—2 HP Westinghouse, TEBB, Parallel Shaft, Type CS, Frame 225, 166 RPM, 3 Phase, 60 Cycle, 220/440 Volts.

15—3 HP G.E., BB, Parallel Shaft, Type MJ Frame 254, 103 RPM, 3 Phase, 60 Cycle, 220/440 Volts.

MOTOR GENERATOR SETS

10—20 KW G.E. Motor Generator Sets, 250 Volts DC, Type CDM, BB, 1800 RPM with 30 HP G.E., Frame 365, Type KF, 1800 RPM, 3 Phase, 60 Cycle, 220/440 Volts.

All of this equipment is in our own stock for quick shipment at attractive prices.

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1—300 HP Westinghouse, Type CS, OSB, Frame 1106, 600 RPM, 3 Phase, 60 Cycle, 2300 Volts.

1—200 HP Westinghouse, Type CS, OSB, Frame 950.01H, 1200 RPM, 3 Phase, 60 Cycle, 440 Volts.

1—200 HP Wagner, OSB, Type 38T5BH, 720 RPM, 3 Phase, 60 Cycle, 2300 Volts.

1—150 HP Wagner, OSB, Type 38T5BH, 600 RPM, 3 Phase, 60 Cycle, 2300 Volts.

10—200 HP Wagner, Type RP2 SB, Frame 26, 1800 RPM, 3 Phase, 60 Cycle, 440 Volts.

10—75 HP Wagner, Type CP1 TEFCBB, Frame 504, 1800 RPM, 3 Phase, 60 Cycle, 220/440 Volts.

10—60 HP Wagner, Type CP1 TEFCBB, Frame 445, 1800 RPM, 3 Phase, 60 Cycle, 220/440 Volts.

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DIESEL UNITS

HP	MFR	MODEL	RPM	PRICE	CONDT.
80	F&M	34-B	400-800	$ 800	Recondt.
120	Atlas		600	1500	Rebuilt
120	Atlas	(Dismantled)	600	500	As is
140	Atlas	(W/clutch)	600	950	As is
150	F&M	32-E-14	300	2250	Good
150	F&M	HD-4400	450	2000	Rebuilt
180	F&M	35-HE	450	3200	Good
185	Buda	D-1742	900	3000	Rebuilt
240	F&M	32(w/gen)	257	6000	Modernized
240	F&M	Y-VA (w/gen)	257	2750	Good
360	F&M	Y-VA	257	5000	Good
360	F&M	32	257	7500	Modernized

3 ph.—GENERATORS—60 cycle

KW	MFR	VTS	TYPE	RPM	PRICE	COND.
75	F&M	240	D	257	$ 750	Ex
180	G.E.	480	ATB	600	1750	Ex
200	F&M	480	D	257	1250	Ex
200	F&M	480	D	257	1250	Ex
250	Westg	240	3-brg.	450	2000	Good
250	F&M	2300	D	257	1500	Good

3 ph.—MOTORS—60 cycle

HP	MFR	VTS	TYPE	RPM	PRICE	CONDT.
15	Imp.	220	EE-45	750/360	$200	Good
50	G.E.	440	FTR552	600	550	Recondt
75	F&M	2300	N	1800	500	Good
75	Westg	440	CW	1750	675	Recondt
75	G.E.	220	MT537	1750	605	Recondt

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6 OIL FIRED B&W BOILERS

Heating Surface	**11417 Sq. Ft.**
Horse Power	**1141.7**
Design Pressure	**210 P.S.I.G.**
Working Pressure	**200 P.S.I.G.**
Capacity	**75,000 lbs./hr.**
Steam Temperature	**Saturated**
Furnace Volume	**1024 Cu. Ft.**
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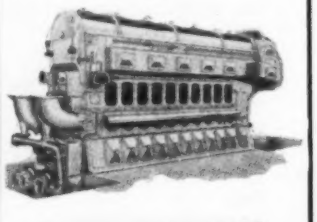

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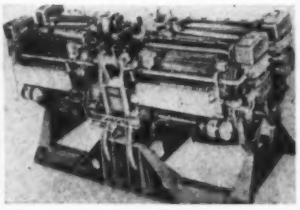

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Steam Driven Air Compressor, Modern Type, 4500 CFM. at 100 psi., in one or two units.

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WATER TUBE BOILER

1 (One) one thousand horse power sectional header, 4 inch water tube boiler, approved 200# pressure.

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2500 KW STEAM TURBINE

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The Texas Division
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3—1667 transformers, single phase, GE Co., Prim. 2300/4600/13,800 V Sec. 4800/4800 V. Type H Form VDD 60 Cycles 01BC

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AMERICAN WRITING PAPER CORP.
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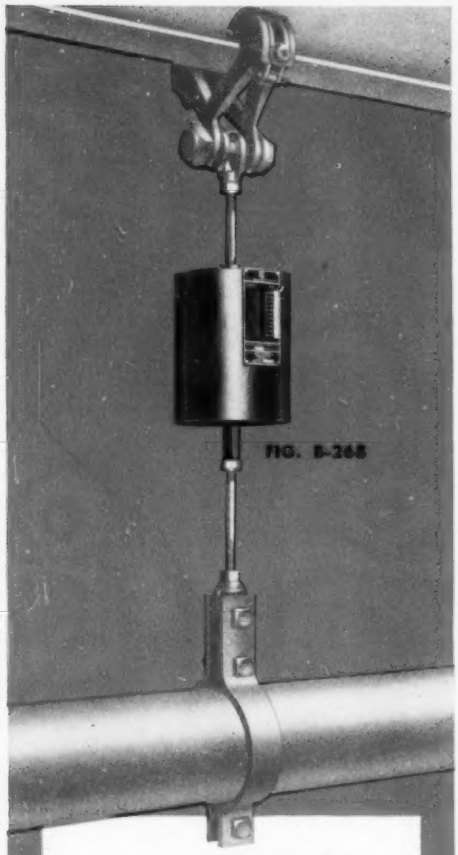
Milwaukee 7, Wis.

P551

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES



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with

Grinnell Pre-engineered Spring Hangers

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range where variation in supporting force is at a minimum.
- Compact—minimum headroom made possible by precompression*.
- Guides prevent contact of coils with casing wall or hanger rod and assure continuous alignment and concentric loading of spring.
- All-steel welded construction meets pressure piping code.
- 16 sizes available from stock — load range from 74 lbs. to 9000 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.
- Unique swivel coupling provides adjustment and eliminates turnbuckle.

**Precompression is a patented feature.*

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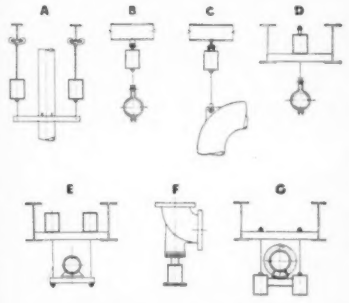

(A) Rod threaded to top cap (B) Furnished with single lug (C) Two lug style (D) Top adjusting (E) Adjustable top and bottom (F) For floor support (G) Trapeze assembly.

FOR LESS VARIATION IN SUPPORTING FORCE — FIG. 98

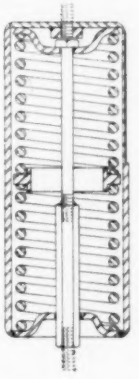

Fig. 98 is an adaptation of Grinnell's popular spring hanger, Fig. 268. It consists of two springs arranged in series within a single casing. A centering guide insures the permanent alignment of the spring assembly.

Fig. 98 has half the load deflection rate, and double the total working range of Fig. 268. Its 16 spring sizes accommodate loads from 74 lbs. to 9000 lbs. — but with a total working range *up to 5 inches!* Fig. 98 comes in the same seven types as shown for Fig. 268. Design details for identical types and sizes are the same for Fig. 98 and Fig. 268.

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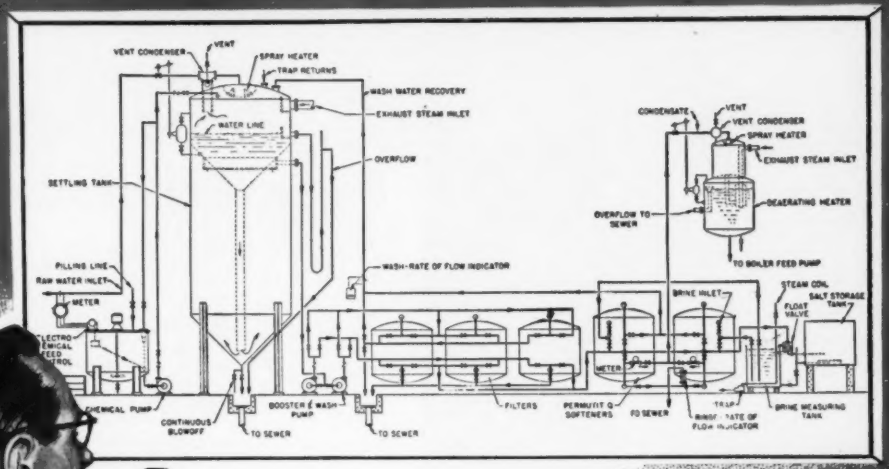

"...have you heard about Permutit's New Hot Zeolite Process?

"Permutit announced the process only a few months ago, but already we're putting it to good use in our plant. We think it's the best way of producing water that's low in alkalinity and silica . . . and with all hardness removed."

"Say, Ed, that's really something . . . getting an effluent of zero hardness from a hot lime soda softener! How's it possible?"

"Well, you see, Joe, they've developed a new mineral, Permutit Q. It's an ion exchanger that will withstand boiling water with a pH over 10, and it's not affected under operating conditions like that even after 1300 regeneration cycles."

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"It is, and what's more, it reduces CO_2 in the steam. I'm really sold on this new process, because our chemical costs are lower, our effluent is lower in alkalinity and total solids, and we don't need acid feeding to prevent deposits in our high stage heaters and economizers."

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"If you write to Permutit, they'll send you a new bulletin *full* of information. I have their address somewhere . . . oh yes! It's The Permutit Company, Dept. P-6, 330 West 42nd Street, New York 18, N. Y. Then there's the Permutit Company of Canada, Ltd. at 6975 Jeanne Mance Street, Montreal."

"Thanks for the tip, Ed. I'm sending them a letter today!"

Water Conditioning Headquarters for Over 37 Years

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